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Warehouse Logistics Optimization at kencko

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Master in Management

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Dedicado à Maggie Simpson Costa. Descansa em paz, Gordji.

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Resumo

Este documento descreve um projeto em empresa realizado para resolver um problema organizacional no âmbito da gestão. Este projeto foi realizado nas áreas de Gestão de Armazém e Inventário na kencko, uma start-up portuguesa que reinventa produtos biológicos de fruta e vegetais. O problema de pesquisa do projeto estava relacionado com um armazém de um operador logístico subcontratado (3PL) usado pela kencko para armazenar a grande maioria do seu inventário. Este projeto resume-se na otimização e documentação dos processos logísticos entre a kencko e o 3PL e na avaliação do desempenho de ambos no registo do inventário armazenado no armazém 3PL.

Para a metodologia de pesquisa, após contextualizar o projeto, uma revisão bibliográfica relacionada com o assunto em questão será fornecida e utilizada como base para a recolha de informação e dados para resolver o problema de pesquisa. Será realizada uma pesquisa mista, recolhendo informação por métodos qualitativos e quantitativos. A análise desta informação permitirá tomar decisões sobre que soluções desenvolver e implementar para otimizar esta relação com o 3PL.

Os resultados deste projeto foram: a otimização dos processos logísticos de entrada e saída de inventário do armazém 3PL; a realização correta das atividades de registo dos movimentos de inventário no armazém 3PL; a documentação de processos relacionados com o 3PL; e a avaliação da kencko e do 3PL na precisão do registo de inventário, com resultados satisfatórios obtidos. Este projeto criou valor para a kencko, pois resolveu um problema nas operações de rotina e estratégicas da empresa.

Palavras Chave: Processos Logísticos de Entradas e Saídas; Armazém 3PL; Procedimentos; Contagem de Inventário; Precisão de Registo de Inventário.

Classificação JEL: L80 – General Industry Studies: Services; M10 – General Business Administration.

Abstract

This paper describes an in-company project performed to solve an organizational problem under the scope of management. This project was carried out in the areas of Warehouse and Inventory Management at kencko, a Portuguese start-up that reinvents organic fruit and vegetable products. The project's research problem was related to a third-party logistics (3PL) warehouse used by kencko for its inventory storage. This research project summarizes in the optimization and documentation of the logistics processes between kencko and the 3PL and the evaluation of both parties' performances regarding the recording of the inventory stored at the 3PL warehouse.

For the research methodology, after a contextualization of the research project, an extensive literature review related to the matter in hand will be provided and used as the basis for information and data gathering to solve the research problem. A mixed research will be performed by gathering information and data through qualitative and quantitative methods. The analysis of this information will allow to make decisions on what solutions to develop and implement to optimize kencko's relationship with the 3PL.

The results from this in-company project were: the overall optimization of the inbound and outbound logistics processes regarding the 3PL warehouse; successfully performing the recording activities of inventory movements at the 3PL warehouse; the documentation of several 3PL-related processes; the evaluation of kencko's and the 3PL's inventory record accuracy, with satisfying obtained results. This research project created value to kencko as it solved an existing problem in the company's routine and strategic operations.

Keywords: Inbound and Outbound Logistics Processes; 3PL Warehouse; Procedures; Inventory Count; Inventory Record Accuracy.

JEL Classification: L80 – General Industry Studies: Services; M10 – General Business Administration.

Index

Acknowledgements	i
Resumo.....	iii
Abstract.....	v
List of Figures.....	xi
List of Acronyms & Initialisms	xiii
Chapter 1: Introduction	1
1.1 kencko's Introduction	1
1.2 kencko's Contextualization.....	1
1.3 Research Problem, Research Aim & Research Question.....	3
1.4 Research Objectives.....	5
Chapter 2: Literature Review	7
2.1 Supply Chain Management, Inventory Management & the Agro-Food Industry	7
2.2 Warehouse Management.....	8
2.3 Third-party Logistics (3PL) Service Provider	8
2.3.1 Service Measurement of 3PL Relationships	9
2.3.2 Performance Measurement of 3PL Relationships.....	10
2.4 Inventory Record Accuracy & Physical and Cycle Counts.....	11
2.5 Information Technology & ERP Systems	13
2.6 Development of Procedures for Processes	15
2.7 Final Remarks on the Literature Review	16
Chapter 3: Methodology	17
3.1 Research Context	17
3.2 Research Design for Information and Data Collection.....	18
3.3 Qualitative Research Procedure	18
3.4 Quantitative Research Procedure	20
Chapter 4: Presentation and Analysis of the Information	23
4.1 kencko's SC Operations & 3PL Warehouse's Role	23
4.2 Inbound Logistics Processes at the 3PL Warehouse Before ERP Implementation.....	24

4.2.1 Delivery Notice to the 3PL	24
4.2.2 Delivery Storage and Notification.....	25
4.2.3 Mistakes Made in the Inbound Logistics Processes.....	25
4.3 Outbound Logistics Processes at the 3PL Warehouse Before ERP Implementation ...	27
4.3.1 Transfer Order from kencko to the 3PL.....	27
4.3.2 Transfer Order Preparation and Dispatch	27
4.3.3 Transfer Receipt at kencko's Fulfillment and In-house Packing Warehouses	28
4.3.4 Mistakes Made in the Outbound Logistics Processes	28
4.4 Recording and Tracking of Batch Codes and BBDs.....	30
4.5 ERP System Implementation	31
4.6 kencko's Documentation on 3PL Processes	33
4.7 Measurement of the 3PL's IRA Performance	35
4.8 Measurement of kencko's IRA Performance	35
4.9 SKU Integrity - IRA KPI	36
4.10 Absolute Deviation - IRA KPI	36
Chapter 5: Implementation	39
5.1 Corrections Made for 3PL Inbound Logistics Processes	39
5.2 Corrections Made for 3PL Outbound Logistics Processes.....	40
5.3 Procedures' Development for 3PL Warehouse Processes	41
5.3.1 <i>3PL Inbound Logistics Processes and 3PL Outbound Logistics Processes</i> Procedures.....	41
5.3.2 <i>Inventory Count at 3PL Warehouse Procedure</i>	42
5.3.3 <i>IRA Measurement - 3PL Warehouse Procedure</i>	42
5.4 IRA Measurement - SKU Integrity and Absolute Deviation Analyses.....	43
5.4.1 3PL - WMS's IRA Performance	43
5.4.2 kencko - Google Sheets Documents' IRA Performance.....	44
5.4.3 kencko - ERP System's IRA Performance	45
5.4.4 Root Cause Analyses of Detected Discrepancies	46
Chapter 6: Conclusions, Limitations & Recommendations.....	47

6.1 Conclusions	47
6.2 Limitations.....	49
6.3 Recommendations	49
References.....	51
Appendices	55
Appendix A - <i>3PL Inbound Logistics Processes Procedure</i>	55
Appendix B - <i>3PL Outbound Logistics Processes Procedure</i>	61
Appendix C - <i>Inventory Count at 3PL Warehouse Procedure</i>	67
Appendix D - <i>IRA Measurement – 3PL warehouse Procedure</i>	73
Appendix E - <i>3PL’s WMS IRA Results from the 26th of January’s Physical Count</i>	84
Appendix F - <i>3PL’s WMS IRA Results from the 16th of February’s Physical Count</i>	85
Appendix G - <i>3PL’s WMS IRA Results from the 5th of May’s Physical Count</i>	86
Appendix H - <i>kencko’s Google Sheets IRA Results from the 26th of January’s Physical Count</i>	87
Appendix I - <i>kencko’s Google Sheets IRA Results from the 16th of February’s Physical Count</i>	88
Appendix J - <i>kencko’s Google Sheets IRA Results from the 5th of May’s Physical Count</i> ..	89
Appendix K - <i>kencko’s ERP IRA Results from the 5th of May’s Physical Count (Quantities)</i>	90
Appendix L - <i>kencko’s ERP Results from the 5th of May’s Physical Count (Batch Codes & Quantities)</i>	91

List of Figures

<i>Figure 4.1 – Flowchart of kencko's SC Physical Flow Operations</i>	23
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List of Acronyms & Initialisms

3PL – Third-party Logistics

SC – Supply Chain

ERP – Enterprise Resource Planning

WMS – Warehouse Management System

SKU – Stock Keeping Unit

KPI – Key Performance Indicator

IRA – Inventory Record Accuracy

SKUI – Stock Keeping Unit Integrity

AD – Absolute Deviation

BBD – Best-before Date

OTW – On-the-way

Chapter 1: Introduction

1.1 kencko's Introduction

kencko, Japanese for “health”, is a Portuguese start-up founded in 2017 that dedicates its business to reinventing organic fruit and vegetable products. This smart food company helps people to eat healthier by reaching the recommended 5 daily servings of fruit and vegetables by dietitians in a more convenient and easier way, as well as to waste less food. For these goals to be achieved, kencko focuses on creating and selling a variety of products that exclusively contain organic plant foods that are flash-frozen and slow-dried before being mixed and transformed into finished products.

For the development of this thesis, an in-company project was performed to solve an organizational problem under the scope of management. This in-company project was carried out in the areas of Warehouse and Inventory Management at kencko. More specifically, the project's problem was related to a third-party logistics (3PL) warehouse used by kencko for the storage of the big majority of its inventory.

1.2 kencko's Contextualization

Warehouses are very important elements in the majority of supply chains (SCs) (Baker & Halim, 2007) and their operations are vital for the success of any of those SCs (Faber et al., 2018). They are mostly known for the activities of storing physical goods to later sell them or further distribute them, but they are also crucial for other operations (Higginson & Bookbinder, 2005). That being said, it is possible to say that warehouse performance, in terms of the effectiveness and efficiency of its processes, is a crucial element in a company's supply chain success (Reiner & Hofmann, 2006). To meet the desired performance levels, there is, then, a need from companies to strengthen warehouse and inventory management by understanding the logistics behind the several processes and activities that occur in their warehouses and the interactions companies have with them.

For context, kencko has been relying on 3PL services for the warehousing and transportation of its inventory to the desired facilities for further operations. Recently, kencko had decided to transition from a partnership with a 3PL warehouse provider to another one. This decision was made mainly due to the fact that the first 3PL provider had gone through several strategic changes that led to a drastic decrease in the effectiveness and efficiency levels of the services provided regarding the storage and shipment of inventory.

After making the decision to terminate the contract with this 3PL warehouse provider, kencko's SC department found and signed a deal with a new 3PL in the hope of reaching the intended service levels. On a side note, kencko's SC department is responsible for almost every process in the SC distribution, apart from the customer orders' fulfillment and dispatch, which is allocated to the company's Operations department. Therefore, kencko's SC department is, in this case, in charge of the company's 3PL warehouse, although the Operations department also has interactions with it. That being said, kencko has then started operating with the new 3PL warehouse provider since October of 2021 and it has been adapting its own processes to this change, while also trying to evaluate if the required performance levels for the new 3PL are met.

However, the adaptation process for kencko also created some difficulties for the company's SC managers since there were a lot of negative aspects that already existed before this 3PL transition. These difficulties experienced by kencko translated into the company's processes and actions not being optimized and efficient in regard to the 3PL, including the interactions that occur between both parties. This situation ultimately led to kencko's inability to correctly record and track the inventory movements occurring at the 3PL warehouse, possibly creating several inventory discrepancies, and to know if the company's and the 3PL's inventory records were accurate or not.

Furthermore, another problem regarding kencko's adaptation process to the operations with the new 3PL warehouse was related to the documentation on these processes between both parties. In fact, the only document containing some information in regard to this aspect was the original contract signed by kencko and the 3PL. According to kencko's SC managers, this contract was insufficient to understand and to have a clear, detailed view on how the several processes and actions between kencko and the 3PL should be done in regard to the physical and information flows. That being said, several of these processes and actions were not documented anywhere and the ones that were indeed mentioned in the contract were not very detailed and just gave a general view to the readers. kencko's SC managers also stated that this lack of documentation created a sense of unclarity and especially impacted the internal actions performed by kencko's SC and Operations departments, such as several issues occurring during the recording and tracking of the inventory movements at the 3PL warehouse.

An additional element to the context of the in-company project at kencko is the implementation of the company's first and cloud-based Enterprise Resource Planning (ERP) system. Until this point in time, kencko had been exclusively operating with several Google Sheets documents, shared among kencko's employees, to register, track and to perform any other activities for the company's inventory management. Google Sheets is a spreadsheet

program offered by Google that belongs to the web-based and free Google Docs Editors suite within the Google Drive Service. As kencko's employees started working with Google Sheets, several distinguished documents started being developed for different purposes related to the daily routine activities performed. This eventually became a problem for kencko due to the non-existence of a single system for sources of databases, information and operations and due to the lack of uniformity of arrangement and information display. Moreover, the tools and features offered by Google Sheets were insufficient for kencko's operations to be performed in a satisfactory way and did not allow a proper and detailed inventory recording, tracking and control. So, kencko's SC managers had already made the decision of transitioning from the Google Sheets documents to a new cloud-based ERP system and were in the planning process for its implementation.

Last but not least, another component of the proposed in-company project by kencko corresponds to the evaluation of kencko's and the 3PL's performances regarding the recording of the inventory stored at the 3PL warehouse. This is an important aspect in inventory management as a company should always look for having its inventory records as close as possible to the actual inventory levels (Al Barrak et al., 2017; Brown et al., 2001; DeHoratius & Raman, 2008; Wild, 2004). If not given the proper attention, the misinformation from inaccurate inventory records could lead to forecast errors, out-of-stock or excess inventory situations and a lack of awareness of sudden inventory losses (Al Barrak et al., 2017; Kang & Gershwin, 2005; Moussaoui et al., 2016; Wild, 2004). Due to kencko's optimization problems regarding the processes around the 3PL warehouse, such as the inability to correctly record and track the inventory movements, it would be necessary to evaluate how the situation of kencko's and the 3PL's inventory records was at the time. Furthermore, it would also be important to evaluate this aspect after corrective measures had been taken to solve kencko's operational gaps and optimization problems in these processes. This comparison would allow to see if better results had been reached in kencko's inventory records, while also focusing on the evaluation of the 3PL's performance on this matter too.

1.3 Research Problem, Research Aim & Research Question

The previously described context has led to kencko offering the opportunity to perform an in-company project with the task of fixing operational gaps and optimizing the processes and interactions between kencko and the 3PL warehouse provider. That being said, the research problem of this project corresponds to the lack of optimization and documentation of the logistics processes between kencko and the 3PL and to the inability of evaluating both parties' performances regarding the recording of the inventory stored at the 3PL warehouse. In terms

of the scope for this research project, kencko's 3PL warehouse will be the core and primary focus of the research problem. Furthermore, there are also several elements in regard to kencko and 3PL warehouse that will play important roles or that are related to this research project, such as: kencko's Google Sheets documents and cloud ERP system; the 3PL's employees, Warehouse Management System (WMS) and online portal; kencko's suppliers; kencko's in-house and external packing warehouses; kencko's in-house and external order fulfillment warehouses; and kencko's SC and Operations departments.

Due to the important role that the 3PL warehouse has in kencko's processes, it is crucial to guarantee that this research project on warehouse and inventory management will, indeed, translate into satisfying results for the company. In order to clarify the purpose of this project and to state what is intended to be achieved with it, it is required to establish a clear research aim that will guide to the solution of the research problem. That being said, the research aim of this project is to reach and implement solutions for the optimization and documentation of the logistics processes between kencko and the 3PL and to evaluate both parties' performances regarding the recording of the inventory stored at the 3PL warehouse.

In order to understand how to approach this research project, an important question will be raised beforehand. By raising this question, it will serve as a foundation of the research project and provide a clear path to solve the research problem. Therefore, the research question is:

- How should the optimization and documentation of the logistics processes between kencko and the 3PL be performed and how should both parties' performances regarding the recording of the inventory stored at the 3PL warehouse be evaluated?

It is important to mention that this research project will have a direct impact in kencko's operations since it is a required project established by the company. This project needs to be correctly performed in order to satisfy kencko's need of optimizing the processes around the 3PL warehouse in the short and long terms to avoid negative consequences that could arise and with great costs to the company. Additionally, it is hoped that this research project brings academic relevance to the areas of SC Management, Warehouse and Inventory Management and Logistics as it contains the resolution of a problem that provides practical information on the subject and serves as an example for the resolution of other similar problems in specific settings.

1.4 Research Objectives

Having identified the research problem, aim and question, it is now necessary to set concrete and important objectives to express how the research process will be structured. These research objectives are, therefore, the necessary steps to be taken to achieve the established aim for this research project and to answer the research question. From the tools that will be needed to perform this project and solve its problem, it is possible to mention some examples, such as: kencko's Google Sheets documents and other Google Sheets spreadsheets; Google Docs program; kencko's cloud ERP system and its user guide and tutorial videos; the 3PL's WMS/online portal. That being said, the research objectives for this research project are to:

1. Investigate the context of the research problem by understanding the company's needs and requirements for this project;
2. Define important concepts and highlight several topics and practices on warehouse and inventory management, inventory recording, inventory traceability and control, ERP implementation, processes' documentation, measurement of inventory record accuracy and other managerial functions through a detailed literature review;
3. Find ways of optimizing the processes regarding the interactions between kencko and 3PL warehouse;
4. Identify and fix operational gaps, such as mistakes and inefficiencies performed by kencko, still in the pre-ERP scenario through the use of Google Sheets documents, and the 3PL;
5. Facilitate the launch of kencko's new ERP system in regard to recording activities;
6. Investigate how to properly document the processes regarding the 3PL warehouse and what possible additional information to include;
7. Find ways of evaluating kencko's and the 3PL's performances in the recording of the inventory stored at the 3PL warehouse, as well as the inventory movements that occur.

To sum up, all the content and aspects presented until now will be further discussed throughout this paper that is composed of, besides this introduction: a relevant literature review related to this research project; a methodology to explain how the information to solve the research problem will be gathered and analyzed; the presentation and analysis of that same information; the implementation of the developed solutions for the research problem according to the analyzed information; and a relevant conclusion to summarize and comment on the final results achieved, to present limitations to the research and to make recommendations for future work.

Chapter 2: Literature Review

2.1 Supply Chain Management, Inventory Management & the Agro-Food Industry

According to LeMay et al. (2017, p. 1446), SC management is “the design and coordination of a network through which organizations and individuals get, use, deliver, and dispose of material goods; acquire and distribute services; and make their offerings available to markets, customers, and clients”. In other words, for the management of the SC, it is important to have a SC integration which includes the design of coordinated physical and information flows that allow organizations to implement smooth processes in the entire SC, as well as exchange processes and coordination tactics between partners (Vanpoucke et al., 2017).

Inventory management, in this case, is a vital management component in SC management and it is one of the key factors that contribute to reaching good manufacturing and service results in a company's operations (Al Barrak et al., 2017). Moreover, one of the main factors regarding inventory management that have an influence on the performance of companies' services to customers is the selection of partners for the functioning of the SC to satisfy the demand (Wanke, 2014). Going into detail, the SC of a company includes a network of facilities (factories, warehouses, terminals, stores, and others) and vehicles (trains, trucks, cargo ships, planes, and others) connected by enterprises, suppliers, and customers through logistics systems (Frazelle, 2002). Logistics, in turn, refers to what happens throughout the SC in terms of activating and linking these components through activities like inventory management, supplying, warehousing, transportation and customer response (Frazelle, 2002).

In the agro-food industry, food loss throughout an entire SC, manufacturers included, has become a major topic of concern (Kayikci et al., 2020). Food traceability is, in turn, a key component of inventory management that ensures food safety in the global SC of the multi-trillion-dollar food industry (Yu et al., 2020). It is described as the ability to trace any food product or component through all the stages in a company's SC, more specifically in production, processing and distribution and it is seen as a crucial factor in the delivery of high-quality products to customers (Yu et al., 2020). The use of modern and smarter information technologies like cloud computing, which includes ERP and WMS systems, is the key for a stronger and viable traceability as they give the ability to collect and analyze any food data in real time and make any corrections if necessary (Kayikci et al., 2020; Yu et al., 2020). Thus, implementing a stronger traceability in the food SC will guarantee greater food safety and reduction of food waste or loss, as well as increasing the performance of routine operations through a better visibility on the inventory stored at each location (Kayikci et al., 2020; Yu et al., 2020).

2.2 Warehouse Management

When it comes to the use of warehouses in the SC, they end up having a critical intermediate role among other SC members and affecting SC services and costs (Baker & Halim, 2007; Kiefer & Novack, 1999). This intermediate role can be subdivided in several operations, such as consolidation centers, cross-docks, product-fulfillment centers, assembly facilities, transshipment facilities, returned good depots, and miscellaneous activities (Higginson & Bookbinder, 2005).

Warehouse management includes establishing links between several logistics processes and activities that occur in a warehouse or that interact with it (Wu & Dong, 2007). These interactions have been increasing the complexity of warehouse management, creating the need for a focus on warehouse performance optimization (Wu & Dong, 2007). To understand the topic of warehouse performance, a performance analysis is referred to as the consistent, periodic “measurement and comparison of actual levels of achievement with specific objectives [...] to measure the efficiency of resource allocation and the outcome of corporate objectives” (Lu & Yang, 2010, p. 285). With that said, warehouse performance has the purpose of helping an organization to not only evaluate the performance of a warehouse’s processes, but also to make decisions, in consequence of that analysis, to optimize those processes (Staudt et al., 2015). For the warehouse performance analysis, several direct and indirect indicators are established, depending on which ones are more adequate to give the desired data for companies (Staudt et al., 2015). The indirect indicators refer to complex qualitative measures, such as customer perception, warehouse capability and automation. Focusing on the direct indicators, these refer to simple and straightforward equations of quantitative measures like costs, accuracy of inventory records, order cycle time, fill rates and several other indicators (Staudt et al., 2015).

2.3 Third-party Logistics (3PL) Service Provider

According to Rajesh et al. (2011), a 3PL relationship is a partnership between a shipper and a third party that, regarding basic services, provides more specialized offerings, covers a wider range of service functions, and is marked by a long-lasting, more beneficial collaboration for both parties. The significance of 3PLs in managing inbound and outbound logistics processes and customer and supplier relationships in SC management has been highlighted by increased globalization and the resulting competitive pressures (Rajesh et al., 2011). From several criteria, cost savings and hopes for better service from outsourcing are two of the most frequently mentioned justifications for companies to outsource logistics processes (Rajesh et al., 2011). Other important variables include the need to enhance productivity, gain more

resources for logistics activities, concentrate on core skills, optimize SC management, improve information technology capabilities, and respond to environment changes (Rajesh et al., 2011). The number of criteria that exists for this decision suggests that businesses believe 3PL service providers might help them in several ways to solve their business difficulties (Rajesh et al., 2011).

Also, since 3PL service providers are becoming more important in the context of SCs, a strong communication and partnership with their clients are crucial to be able to comprehend their businesses and help them improve the SC processes (Huemer, 2012; Rajesh et al., 2011). That way, the performance of the SC will increase as 3PL service providers and their clients develop closer ties and become more aware of how the actions related to the interactions between each one are performed (Huemer, 2012; Rajesh et al., 2011). In the SC, these complex collaborations only succeed when a common set of goals and objectives is shared by both the 3PL provider and its client and when there is a proper information exchange about planning, execution, management and, finally, a measurement of the service and performance levels (Huemer, 2012; Rajesh et al., 2011).

2.3.1 Service Measurement of 3PL Relationships

Although many 3PL service providers now conduct self-evaluations on their services, the logistics clients sometimes lack the evaluation of how they perceive and think about their logistics partnerships and the services received (Rajesh et al., 2011). Therefore, while evaluating 3PL relationships, it is equally important to consider both the clients' perceptions and the 3PL service providers' own assessments of the logistics relationships and service levels (Rajesh et al., 2011). By performing the evaluation of the 3PL's services, not only the clients may take and share their own conclusions on the services received, but also allows the 3PL to analyze them by becoming more proactive and concentrating on the essential aspects that will strengthen and ensure the success and continuity of the existing connection (Rajesh et al., 2011).

That being said, there are multiple success factors for the relationships between 3PL providers and their clients that play an important role in the beginning, strengthening and duration of those relationships (Li, 2011; Rajesh et al., 2011). Going into detail, there are several service elements, such as service level management, integrity, transparency, information sharing and honoring of the contract agreement, that are crucial for positive relationships between 3PL providers and their clients (Li, 2011; Rajesh et al., 2011). Service level management relates to the necessity of creating a strong relationship between both parties by ensuring that the 3PL's intentions toward its customers are to help them achieve the

desired results (Hsiao et al., 2010; Li, 2011; Rajesh et al., 2011). Integrity corresponds to the levels of consistency of principles, actions, methods, outcome, measures and other aspects that also constitute the 3PL relationship's functioning (Li, 2011; Rajesh et al., 2011). Transparency is related to the 3PL establishing openness toward its clients through transparent aspects like allowing client visits and sharing information on how the 3PL's processes are performed (Hsiao et al., 2010; Li, 2011; Rajesh et al., 2011). Information sharing refers to developing a responsible relationship by establishing a proper and continuous communication between both parties in order for the 3PL to always understand its customers' needs and to quickly and easily fulfill them (Cui & Hertz, 2011; Li, 2011; Rajesh et al., 2011). Finally, honoring the contract agreement translates into both parties' responsibility to perform the operations according to how it was primarily established, giving the 3PL the freedom to provide the expected service levels, which should be measured to guarantee the established goals are met (Li, 2011; Rajesh et al., 2011).

2.3.2 Performance Measurement of 3PL Relationships

Typically, companies want to build long-lasting relationships with 3PL providers, which means that they are often expecting excellent performance levels coming from these relationships in the services provided in order to maintain those relationships (Keramati et al., 2010; Rajesh et al., 2011). To determine if the 3PL provider has delivered its services according to the desired levels, measurements of performance are usually utilized by both the 3PL and its clients (Keramati et al., 2010; Rajesh et al., 2011). With that said, there are ways to improve the services provided and to create value that can be reached through this continuous performance measurement by the 3PL and its clients and through useful communication between both parties about the performance results (Keramati et al., 2010; Rajesh et al., 2011).

Just like for the service measures, there are multiple elements to evaluate the 3PL's performance, such as receipt accuracy, warehouse cycle time, delivery accuracy, on-time deliveries, shortage claims, inventory accuracy, customer service and customer complaints (Keramati et al., 2010; Rajesh et al., 2011). The receipt accuracy refers to administrative paperwork that translates into the act of the 3PL receiving an order and its responsibility to begin the processes that result in the delivery of the goods to the desired locations (Keramati et al., 2010; Rajesh et al., 2011). Warehouse cycle time equals the time taken between an order receipt and the shipment of the goods ordered (Keramati et al., 2010; Rajesh et al., 2011). Delivery accuracy refers to the 3PL's capacity to fulfill its client's orders in terms of the quality and quantity of the goods (Keramati et al., 2010; Rajesh et al., 2011). On-time deliveries

equals the number of deliveries made on time by the 3PL out of the total number of deliveries made (Keramati et al., 2010; Rajesh et al., 2011). Shortage claims are related to a decrease in the quantity of goods stored, in preparation or in shipments, which may occur due to theft, loss, deterioration or other reasons (Keramati et al., 2010; Rajesh et al., 2011). Inventory accuracy refers to the level of accuracy of the inventory records when compared to the actual inventory stored (Keramati et al., 2010; Rajesh et al., 2011). Customer service translates into the range of activities regarding the services provided by the 3PL to its clients (Keramati et al., 2010; Rajesh et al., 2011). Customer complaints is the number of complaints from clients in regard to one or several services provided by the 3PL (Keramati et al., 2010; Rajesh et al., 2011).

2.4 Inventory Record Accuracy & Physical and Cycle Counts

Managing inventory systems usually involves keeping track of several stock keeping units (SKUs), which has led to companies developing inventory control programs in order to reach competitive and economic advantages in the area of warehouse and inventory management (Ernst et al., 1993; Huemer, 2011; Wild, 2004). These inventory control tools may, therefore, translate into the development and implementation of key performance indicators (KPIs) that help with this analysis (Huemer, 2011; Wild, 2004). Thus, inventory management is based on recorded inventory levels that are used to set parameters that influence financial and operational decisions to ultimately optimize inventory control (Al Barrak et al., 2017; DeHoratius & Raman, 2008; Ernst et al., 1993; Kang & Gershwin, 2005; Wild, 2004).

Recorded inventory levels are, in turn, considered to be accurate if they agree with the actual inventory levels (Al Barrak et al., 2017; Brooks & Wilson, 2007; Ernst et al., 1993; Wild, 2004). However, inaccurate recorded inventory levels may lead to out-of-stock situations, due to underordering, ordering too late or not ordering at all, which might translate into lower production productivity and lower service levels such as delivery delays (Al Barrak et al., 2017; Brooks & Wilson, 2007; Ernst et al., 1993; Kang & Gershwin, 2005; Moussaoui et al., 2016). Another possible result for inaccurate inventory records is overstock situations, due to over-ordering or ordering too soon, which may lead to warehouse overloading and higher investment and carrying costs (Al Barrak et al., 2017; Ernst et al., 1993; Kang & Gershwin, 2005; Moussaoui et al., 2016). Another aspect that might be affected by this inaccuracy situation is related to the material requirement planning systems used by several companies in manufacturing industries through, for example, their ERP and WMS systems, which need to be as accurate as possible in order to properly work (Al Barrak et al., 2017).

To sum up, the inventory record accuracy (IRA) of a company is a crucial aspect in inventory management that should be controlled and measured as it can have a direct impact on the efficiency and results of that company's overall activity (Al Barrak et al., 2017; Brooks & Wilson, 2007; DeHoratius & Raman, 2008; Ernst et al., 1993; Wild, 2004). In other words, constantly keeping accurate inventory records will make companies more confident about their results and allow their managers to merely focus on other factors showing real deviations, instead of having to spend time analyzing recorded SKUs that end up having an inaccurate picture (Al Barrak et al., 2017).

According to Al Barrak et al. (2017), companies usually establish inventory check activities at least once a year to measure the IRA and the frequency of this activity varies in each company, not only in terms of the level of care given to it, but also according to how frequently discrepancies are registered and how significant they are. These inventory check activities may be performed through established and organized steps to perform a physical count of all items in a facility and at a certain moment (Al Barrak et al., 2017). At this specific moment, all operations are usually interrupted to proceed with an adequate counting and to avoid jeopardizing the results (Al Barrak et al., 2017). Additionally, the registering systems used by companies, such as ERP and WMS systems, should also be frozen at the same time so that it is possible to later perform a proper comparison between the information from the systems and the physical counts (Al Barrak et al., 2017). However, another way of doing these inventory check activities is by performing several cycle counts (Al Barrak et al., 2017). Cycle counting, in turn, means selecting and counting samples of SKUs in a random or methodical way in terms of the selection of SKU characteristics and periods of time between each count, with the purpose of making an assumption on the overall records' accuracy (Al Barrak et al., 2017).

Brown et al. (2001) analyze the IRA by explaining how to calculate its ratio, which is measured by the number of counted SKUs classified as being correct divided by the total number of counted SKUs. For this ratio, considering the difficulty of having completely accurate results, companies may or may not decide to establish an acceptable range of positive or negative errors up to 5% for the recorded inventory to be considered accurate, i.e., they consider their recorded inventory levels as being correct if the ratio does not surpass that established tolerance (Brooks & Wilson, 2007; Brown et al., 2001). Therefore, this ratio, known as *SKU Integrity* (SKU_I), shows the proportion of the recorded SKUs that match the SKUs' count, as well as the proportion of the SKUs containing errors (Brooks & Wilson, 2007; Brown et al., 2001). However, besides this frequency of error, once an error is registered between the recorded data and the physical count, it is also important to take into account and analyze its magnitude, which indicates the size of those registered discrepancies (Brown et al., 2001; Wild, 2004). In other words, while a small error in a SKU count might be tolerable and easily

corrected by the company, a bigger error magnitude might be more complex to resolve and might also affect the material requirement planning and delivery performance, possibly translating into high inventory costs (Al Barrak et al., 2017; Brown et al., 2001; Wild, 2004).

Therefore, there is also another metric used for the IRA of an inventory management system that considers the magnitude of the encountered errors (Ernst et al., 1993; Wild, 2004). This metric, known as the *Absolute Deviation* (AD), considers the absolute value of the deviation from each SKU's record compared to its actual counted inventory (Ernst et al., 1993; Wild, 2004). After that, in order to measure the error magnitude of the inventory records, the absolute value of the registered deviation of each SKU is then divided by the corresponding inventory record (Ernst et al., 1993; Wild, 2004). So, the AD serves to reflect each SKU's accuracy, i.e., the smaller the calculated AD percentage, the stronger the IRA percentage in the exact same proportion (Ernst et al., 1993; Wild, 2004). Furthermore, in order to evaluate the overall accuracy of all SKUs combined, the formula can also be used by taking the absolute sum of all registered deviations and dividing it by the total inventory records' units (Ernst et al., 1993; Wild, 2004).

By considering the AD, this metric equally measures the understock (negative) and overstock (positive) deviations as both leading to a lower accuracy (Ernst et al., 1993; Wild, 2004). Thus, this metric does not allow to compensate an understock error of one SKU with another SKU's overstock error when performing the total sum of the deviations (Ernst et al., 1993; Wild, 2004). Just like previously mentioned, due to the difficulty of guaranteeing 100% accurate inventory records, it is common for companies to establish a realistic and acceptable tolerance percentage up to 5% for this metric as well in order to take proper conclusions on each SKU's and overall accuracy of the inventory records (Ernst et al., 1993; Wild, 2004). These conclusions may, therefore, lead to companies deciding whether or not to perform root cause analyses on the discrepancies detected to properly correct them (Brooks & Wilson, 2007; Ernst et al., 1993; Wild, 2004).

2.5 Information Technology & ERP Systems

Information technology is essential for the development of modern logistics practices in several industries (Yang & Bi, 2014). Information technology allows information systems to run through several enterprises, greatly improving the efficiency and quality levels of logistics, and it gives the conditions to integrate enterprise demand, inventory management, and distribution (Mao et al., 2018). Logistics information can be used in every logistics process and link for systematic control, such as procurement, storage, and transportation (Mao et al., 2018), and that span of control, within the operations of a warehouse, is considered one of the most important

fundamentals of warehouse management (Frazelle, 2002). Additionally, information technology can perform an effective communication with a continuous connection between the SC operations, giving that SC high speed and efficiency and low-cost advantages (Mao et al., 2018). Thus, the fundamental goal of SC management is to utilize contemporary information technology to improve businesses' core competitiveness (Tibin et al., 2012). In other words, to enhance the SC performance, businesses must integrate and optimize their operational processes and strengthen their relationships with suppliers, partners and clients through information exchange (Tibin et al., 2012).

ERP systems are a good example of information technology practices as they are defined as software packages containing the modules of sales, finance, production, warehousing, human resources and several others that provide integration for an organization as a whole to make information flow in a seamless way through the several business processes (Uppström et al., 2015) and maintain the organization's wide data at a centralized place (Malik & Khan, 2020). These systems are more agile and responsive to changing business needs and their main objective consists of replacing outdated patch work for a synchronized suit at an organizational level, bringing higher efficiency, standardization and harmonization (Malik & Khan, 2020). Furthermore, ERP systems allow users to enter new information at any place in the system that will automatically update all the other associated modules in real time, bringing more operational control and visibility (Malik & Khan, 2020).

ERP solutions have been evolving throughout the years and are currently changing to cloud-based platforms as a hybrid system or even a true cloud ERP system (Demi & Haddara, 2018). There is the need to be careful about the scenario of an organizational growth at a faster pace than its ERP system upgrades, as it will create a gap of new needs for the company that the system will not be able to satisfy (Demi & Haddara, 2018). The expectations for ERP systems are, therefore, to become even more adaptable and flexible than previous platforms (Uppström et al., 2015) and cloud ERP is presented as an answer thanks to benefits of being a more flexible system and allowing lower additional investments (Demi & Haddara, 2018).

For an ERP system to be implemented, an organizational change management needs to be established where there is a high commitment from the people and resources involved as the system is considered to be very complex and organizationally disruptive (Malik & Khan, 2020). Not only that, for an ERP system implementation to be successful, it is also important to guarantee that the post-implementation stage goes according to the overall strategy, as several organizations struggle in this stage with issues due to a lack of strong adoption knowledge (Hasan et al., 2019). Thus, for a successful post-implementation stage, there needs to be an effort from everyone interacting with the ERP system, from the top management to

the end users of the ERP system, which should include a continuous system development and an effective decision support to reach an acceptable level of the business process performance of the organization (Hasan et al., 2019).

2.6 Development of Procedures for Processes

Ahmed et al. (2020) mention that a procedure normally consists of a number of steps containing actions that must be performed in order to reach an objective. A procedure is frequently thought of as the written explanation of these series of activities in the process industries which may then be provided to employees (Ahmed et al., 2020).

These procedures are created and used to help employees successfully finish the proposed tasks in real time and avoid undesirable results, as well as to train employees on new jobs or equipment by using them as training tools (Ahmed et al., 2020). To help the employees complete the activities correctly, procedures might include instructions for each of the task's steps, frequently with precise guidelines (Ahmed et al., 2020). Procedures can be applied to any job aids that enhance performance by also providing information to make it easier to plan and take the appropriate actions for a given activity (Ahmed et al., 2020). Moreover, using procedures throughout routine operations has been found to increase performance (Ahmed et al., 2020; Bullemer & Hajdukiewicz, 2004). However, these procedures are only successful and efficient if they are properly developed, clearly transmit the information and if they are used and followed by employees (Ahmed et al., 2020; Bullemer & Hajdukiewicz, 2004; Bullemer et al., 2011).

Van der Meij and Gellevij (2004) split the information that should be included in a procedure into four categories, as listed below, in order to establish guidelines for its development:

- Goal: the user is shown the goal as a stage that the employees want to and should reach. This could be an intermediate or the overall final stage of the processes described (van der Meij & Gellevij, 2004);
- Prerequisites: this category states the conditions for approaching the processes and reaching the goal. These conditions translate into responsibilities for the users and must be, therefore, respected and fulfilled before the users achieve the goal (van der Meij & Gellevij, 2004);
- Actions and Reactions: the mentioned goals are achieved through the user's actions and the overall reactions that occur in the processes. This category includes the

description of all the established steps and their required actions and it can be split into sub-goals or checkpoints (van der Meij & Gellevij, 2004);

- Unwanted: this category relates to several stages or actions to be avoided during the processes, such as mistakes or inefficiencies. Therefore, not only this category gives guidance and warnings on what situations or aspects to avoid in order to easily and successfully follow the procedure, but also may provide instructions to solve the problems that may occur from them (van der Meij & Gellevij, 2004).

Having explained the structure and content of an adequate procedure, it is also crucial for a company to establish an appropriate approach for its development and implementation to guarantee that all procedures follow the same and correct path (Ahmed et al., 2020). Thus, the procedure life cycle explains the process of how a procedure is created, implemented, utilized and reviewed throughout time (Ahmed et al., 2020). In order to perform this process, the procedure life cycle can be split into four stages (Ahmed et al., 2020). The first stage, which is the procedure plan, design and development, includes the required steps for a procedure's development, such as: verifying the necessity of the new procedure; gathering relevant information; developing the information and instructions for the tasks; establishing responsibilities to guarantee compliance; final review and approval; and publishing of the procedure document (Ahmed et al., 2020). The procedure administration is the second stage and it relates to the procedure's repository, communication and control, which includes the decisions of when, how and to which employees to deliver the procedures (Ahmed et al., 2020). The third stage refers to the eventual implementation and use of the procedure by the employees (Ahmed et al., 2020). After that, a fourth stage is assigned to the review and maintenance of the procedure to evaluate its impact in the performed tasks and to understand if a modification or correction of the procedure is required or not (Ahmed et al., 2020).

2.7 Final Remarks on the Literature Review

The literature review performed is relevant for this research project as it explains the several concepts related to it and it will serve as the basis for further information and data gathering and analysis to reach a solution for the research problem. Thus, the reviewed concepts will have different purposes throughout the research project and at different or simultaneous moments. To conclude, while the purposes of some of these concepts will correspond to required practical uses for the development of the research project, the other described concepts will also be related to the context of this project by interacting or having an impact throughout the course of the corrective actions performed.

Chapter 3: Methodology

One of the required components of this research project at kencko corresponds to the research methodology. Firstly, a brief explanation of the research context and, in turn, the reasons for this research project will be described in order to justify the research problem identification. After that, the research design will also be displayed not only to present, but also to justify the methods, techniques and tools used to collect and analyze useful data and information to solve the research problem. Therefore, the research design will explain how the previously established research question will be answered and how to reach the research aim through the gathering, treatment and analysis of relevant data and information.

3.1 Research Context

Regarding the research context, this project was, as previously described, performed at kencko, a Portuguese start-up founded in 2017 that operates in the smart food industry by freezing, drying and turning fruit and vegetables into different types of innovative products.

From the previously given contextualization, kencko is currently operating with a new 3PL warehouse provider for the storage of the big majority of its inventory and has been adjusting its processes to this change, which is what this research project will be focused on. kencko had decided to start working with this 3PL warehouse provider in October of 2021 due to the drastic decrease in the effectiveness and efficiency levels of the services provided by a previous 3PL warehouse provider. Also, kencko had simultaneously been preparing for the implementation of a new ERP system, while also relying on the use of Google Sheets documents, which would also impact the processes and actions performed in regard to the 3PL warehouse.

Therefore, the purpose and main justifications for this project were the need from kencko to optimize and document the processes around the new 3PL warehouse, to facilitate the ERP launch while also properly using the Google Sheets documents, and to evaluate both kencko's and the 3PL's performances in the inventory recording process. This last component was crucial for this research project as kencko's SC managers were already aware of multiple internal problems regarding the company's inventory records that already existed prior to the 3PL transaction. Thus, the methodology for this research project will be based on the gathering and analysis of data and information that will help to evaluate and implement satisfying solutions for kencko's needs in regard to the 3PL warehouse.

3.2 Research Design for Information and Data Collection

The aspects that constitute the research design are important to be mentioned and clarified as it will bring credibility and transparency to this research project by explaining and giving the details about the procedures that will be taken to solve the research problem. That being said, the research design for this research project is categorized as a mixed research since it will include both qualitative and quantitative methods to obtain relevant data and information for this research project. After gathering the data and information through these methods, the data treatment will be performed to reach clear results. In turn, these results will allow a proper analysis to be made to make conclusions and/or make decisions on what solutions to develop and implement in order to optimize the relationship with the 3PL warehouse.

3.3 Qualitative Research Procedure

On the one hand, the qualitative approach will consist of some methods that are based on the interpretation of immeasurable information and observations gathered throughout the research project, either from secondary or primary data. This obtained information will be related to the 3PL warehouse and to the overall relationship and interactions between kencko and the 3PL warehouse provider, as well as the several internal processes and actions that are performed by each party in this relationship. Generally speaking, some of the resources, tools and practices used will be documents in kencko's SC Google Drive, existing and relatable literature, kencko's Google Sheets documents and ERP system, the 3PL's WMS/online portal, interviews and continuous observation.

In terms of secondary data, i.e., already existing data that will be gathered and analyzed to serve as a basis for the decision-making process to solve the research problem:

- The original contract signed by kencko and the 3PL warehouse provider and stored in the company's SC Google Drive will be analyzed as it is the most detailed and relevant document about the operations regarding the 3PL warehouse;
- The several processes around the 3PL warehouse will be analyzed by gathering information from kencko's Google Sheets documents and the product batch codes' Google Docs and how they are used in this context, as well as emails exchanged between kencko and the 3PL;
- Relevant literature in the areas of warehouse and inventory management will be reviewed to analyze several subjects that this research project will be focusing on, including practices, models, resources and tools. This literature review will be important

to support the development of solutions for the multiple aspects that constitute the research problem by applying relevant findings to the research project;

- The standard procedure template, already developed by kencko on Google Docs and stored in the company's SC Google Drive, for the documentation of processes performed in regard to the company will be analyzed. This template will serve as the basis for the development of documentation of the processes around the 3PL warehouse;
- The user guide made available, in Google Docs' format, to kencko's employees prior to the ERP implementation, along with video recordings on how to perform actions in the system, will be analyzed. This content, which is stored in kencko's SC Google Drive, will be helpful during the development of the processes' documentation in regard to the 3PL warehouse as these documents will be written according to the use of the ERP.

Moving on to the primary data, i.e., data purposely obtained during the research project to specifically address and solve the research problem:

- Some semi-structured interviews in the initial stage of the research project (in December of 2021) will be performed with kencko's SC and Operations managers in regard to the general context of the company's relationship with the 3PL warehouse provider. The reasons for these interviews are to understand the role of the 3PL warehouse in kencko's overall SC and fulfillment operations and to identify the needs and requirements from kencko's SC managers for this research project, including what is expected to have been achieved by the end of it;
- Additionally, several other semi-structured interviews (in January of 2022) will also be done with kencko's SC and Operations managers to specifically gather information on the operations performed around the 3PL warehouse by the two departments and the 3PL's employees, as well as the interactions between both companies. These interviews will also include an initial training process given by kencko's employees in order to understand the actions that are performed in the Google Sheets documents used and, in a later stage, for the ERP system as well. The purpose of these interviews is to gather and analyze the information to proceed with the identification of possible operational gaps and inefficiencies to be corrected, as well as to be able to perform the documentation of the processes regarding the 3PL warehouse.
- A focus group will also be done (on the 2nd of March of 2022) with three 3PL's managers, accompanied by one of kencko's SC managers and one Operations manager, to clarify some aspects from processes and activities performed by kencko

and the 3PL. The purpose of this focus group is for both companies' managers to get some insight on the opinions from both sides regarding the activities performed. Thus, the focus group will be used to discuss some topics to possibly correct existing mistakes or inefficiencies and to ask relevant questions to clarify doubts that may exist on behalf of both parties. Furthermore, this focus group will also be used to clearly understand all the internal actions performed by the 3PL's managers and operators in regard to the inbound and outbound logistics processes to later complement the documentation of the processes;

- In order to guarantee the well-functioning of the inbound and outbound logistics regarding the 3PL warehouse, a continuous observation of their processes (from February to May of 2022) will be required after the corrective actions have been implemented. This observation will include several aspects, such as kencko's internal processes and communication, Google Sheets documents and ERP system, the 3PL's online portal connected to its WMS and the emails exchanged between both parties. This procedure will serve to gather first-hand information about the corrective actions' adequacy and efficiency, as well as to evaluate if the processes and actions are being correctly performed by kencko's SC and Operations departments and the 3PL's employees;
- Some final semi-structured interviews with kencko's SC managers will be performed (In May of 2022) in order to understand their perceptions of the corrective actions implemented in regard to the 3PL warehouse, as well as their opinions on the achieved results according to what was expected to be achieved from the research project.

3.4 Quantitative Research Procedure

On the other hand, the quantitative approach will consist of some methods that are based on measurable information like mathematical calculations and analysis of scores gathered for the research project. This information will be obtained either from secondary or primary data and it will be related to the accuracy of the inventory recording process done not only by kencko's SC and Operations managers but also by the 3PL's managers in regard to the 3PL warehouse.

For these analyses, in terms of resources, tools and practices used: the inventory levels at the 3PL warehouse will be obtained through three physical counts that were performed on the 26th of January, the 16th of February and the 5th of May of 2022; kencko's inventory records will be gathered from the company's Google Sheets documents used for these operations and

the new ERP system; the 3PL's inventory records will be obtained from emails sent by its managers to kencko, after the physical counts have been performed, with the extracted information from their WMS; and, finally, for the data treatment, the calculations for the IRA performances will be performed with the use of the Google Sheets program. In terms of the sample size for the calculations and analyses, the first two physical counts and corresponding inventory records will include the 73 SKUs that could be stored at the 3PL warehouse at the time, while the third physical count and its inventory records will include 79 SKUs that could be stored there. This increase in SKUs in the last physical count is explained by the development of new products and corresponding materials that started being stored at the 3PL warehouse.

In terms of secondary data, the results from the first two physical counts of all the inventory stored at the 3PL warehouse, which were performed in the ERP implementation context, will be gathered along with kencko's and the 3PL's inventory records at the time of those physical counts. This data will be used with the purpose of evaluating kencko's and the 3PL's IRA performances at the time those physical counts took place, i.e., prior to corrective actions being taken to solve the research problem. Also, another secondary data that will be gathered for future analysis is kencko's and the 3PL's inventory records at the time of a third physical count in the context of the IRA performance evaluation and for root cause analyses of detected discrepancies.

In regard to the primary data, it will firstly be obtained from the third physical count at the 3PL warehouse that will be requested to kencko's SC managers and, subsequently, to the 3PL's managers, which will translate into the results of the actual inventory levels. The three physical counts performed will serve to compare the results of the actual inventory levels at each of the three moments with the secondary data of kencko's and the 3PL's inventory records from those moments as well. These three comparisons will be composed of calculations performed for the evaluation of kencko's and the 3PL's IRA performances, meaning that new primary data will be obtained from them. This new primary data will, then:

- Help to analyze the status of the accuracy of kencko's and the 3PL's inventory records around the time of the first two physical counts;
- Help with the analysis of the two companies' inventory records at the time of the third physical count and the impact of all the corrective actions performed regarding the inbound and outbound logistics processes at the 3PL warehouse;
- And, also, allow a final comparison to be made of kencko's and the 3PL's accuracies of the inventory records between the final physical count and the two previous ones.

Chapter 4: Presentation and Analysis of the Information

4.1 kencko's SC Operations & 3PL Warehouse's Role

In terms of the facilities used for the SC operations and physical flow of goods, the operations for food items start from kencko's raw material suppliers that provide food ingredients that are then transferred to kencko's two biggest suppliers, which are also the manufacturers responsible for the mixing process. After the mixing of the ingredients is performed, the mixes are dispatched to the in-house and external packing warehouses to be packed. Once packed with film, the finished products are transferred to the 3PL warehouse, where they are stored and subsequently shipped to the fulfillment warehouses. In a few cases, some finished products from kencko's in-house packing are directly transferred to the in-house fulfillment. In terms of the packing items, the film used is purchased from a supplier and directly shipped to the external packing warehouse or to the 3PL warehouse to be later sent to the in-house packing. Regarding the materials purchased and used in the final packages, the packaging materials and accessories are shipped from the suppliers to the 3PL warehouse to be transferred afterwards to the fulfillment warehouses. The marketing materials used in the final packages are directly sent from the suppliers to the fulfillment warehouses. After preparing the final packages, these are then shipped from the fulfillment warehouses to the end customers.

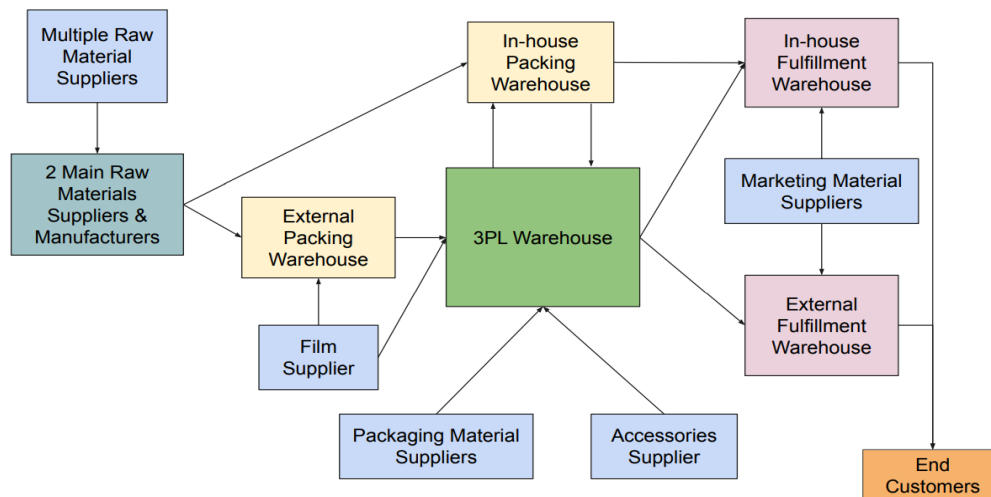


Figure 4.1 – Flowchart of kencko's SC Physical Flow Operations

To conclude, kencko's SC department is responsible for the management of the suppliers, the in-house and external packing processes and, in this case, the 3PL warehouse, while the Operations department exclusively manages the in-house and external fulfillment processes. Moreover, the 3PL warehouse has been playing a very important role in the physical flow of goods for kencko's processes since October of 2021, as previously mentioned. In other words, it has been serving as an intermediate point within the company's SC for the receipt and

storage of most of the inventory, which is then shipped to desired locations once there is a replenishment needed for further operations.

4.2 Inbound Logistics Processes at the 3PL Warehouse Before ERP Implementation

The inbound logistics processes at the 3PL warehouse correspond to both the physical and information flows that occur regarding deliveries made there from kencko's suppliers or from the in-house and external packing warehouses. In this chapter, a description of these processes will be given, according to the pre-ERP scenario, by also focusing on the interactions between kencko and the 3PL. A set of operational gaps, like mistakes and inefficiencies occurring during these processes, will then be presented to show how there is a need for the optimization of the processes.

4.2.1 Delivery Notice to the 3PL

After analyzing the forecasts of what SKUs and amounts to be produced, kencko's SC managers establish the production with the suppliers and the packing process with the co-packer and the in-house packing.

After arranging the production and scheduling the deliveries of the items at the 3PL warehouse, kencko's SC managers then notify the 3PL by registering them in the 3PL's online portal, connected to its WMS, with the items' SKUs, quantities, batch codes, best-before-dates (BBDs) and place of origin. Having done this, the SC managers also send an email with the same information to the 3PL. In a specific case, some deliveries made at the 3PL warehouse are already reserved for containers to be shipped to the external fulfillment warehouse and spend little to no time stored there. However, these deliveries follow the same processes at the 3PL warehouse as the others. According to the contract, all deliveries must be notified to the 3PL at least 24 hours before they arrive at the 3PL warehouse for weekdays or 48 hours before for weekends or holidays.

kencko's SC managers then register these future deliveries with their respective SKUs and quantities in a tab from the Google Sheets documents called *on-the-way (OTW)*. These deliveries are given the *open* status until they have been completed, which is then changed to the *closed* status once the 3PL has notified kencko of their arrival.

4.2.2 Delivery Storage and Notification

After receiving, registering and storing each delivery, the 3PL will let kencko's SC managers know they have arrived, as well as telling the information of the items registered by them. This process is done through an update of the 3PL's WMS on the status of the deliveries from being on the way to its warehouse to being already stored, as well as via email with the required information. According to the contract, all these processes regarding the physical inbound logistics and the information flows need to be performed by the 3PL in the first 24 hours after the delivery has been made and in the first 12 hours for food products.

When receiving a delivery storage update from the 3PL, kencko's SC managers then compare the registered quantities by the 3PL with the quantities that were supposed to be delivered by analyzing the *OTW* tab. Having done that, if the delivery is complete, kencko's SC managers then register the delivery in a tab called *3PL warehouse* and mark it as *closed* in the *OTW* tab.

If the 3PL registers discrepancies in SKUs, quantities, batch codes or BBDs from what was supposed to arrive, they let kencko know of the situation so that the company may check with the supplier or with the packing warehouses to see if there was a mistake made in the shipment to the 3PL warehouse. If a mistake has been made, then both kencko and the 3PL register the delivery with the correct details. If no mistake has been found, kencko may eventually proceed with a stronger investigation and reach a conclusion along with the 3PL on what to register.

4.2.3 Mistakes Made in the Inbound Logistics Processes

Following the description of the processes regarding the inbound logistics at the 3PL warehouse, it is possible to mention some mistakes and inefficiencies that were being made by kencko's SC managers and the 3PL. These mistakes were occurring several times during some of the processes and in an inconsistent way, which made it difficult and more complex for the SC managers to perform root cause analyses to correct each mistake. Furthermore, these mistakes and inefficiencies were either occurring in the internal documents used by kencko to register the deliveries made or in the processes in which there were interactions with the 3PL, including their WMS. The most regular and relevant mistakes being made were as follows:

- In a focus group on the 2nd of March of 2022 with the 3PL's and kencko's managers, one of the points discussed was the act of registering future deliveries at the 3PL warehouse on its online portal and within an established timetable according to the

contract. The 3PL's managers explained that these scheduled deliveries were not being registered by some of kencko's SC managers on the online portal and only an email would be sent, apparently due to a prior lack of clarification on this matter. Also, they mentioned that these scheduled deliveries were not always being notified to the 3PL at an appropriate time. Therefore, the 3PL's managers asked if it would be possible for kencko's employees to start registering all these deliveries in the online portal, to avoid misunderstandings like deliveries not being registered, and within the established timetable.

- The *OTW* tab in kencko's Google Sheets documents was not being used, which led to this safety step being erased and, consequently, deliveries being forgotten to be registered once they arrived, creating big discrepancies from kencko's perspective;
- Not all deliveries at the 3PL warehouse were being reported via email by the 3PL to kencko once they arrived and some of them were being reported a long time after the established timetable in the contract. Since kencko awaits the 3PL's email confirmation of a delivery in order to register it, this led to several deliveries not being registered by kencko, creating big discrepancies on kencko's inventory records once again. This issue was brought up in the focus group with the 3PL's managers to explain the importance of this step;
- When sending the email confirmation of a certain delivery, the 3PL would sometimes forget to mention discrepancies in the items' details according to what was supposed to arrive. This issue was also mentioned and explained in the focus group performed with the 3PL's managers for them to be aware of the situation;
- After the 3PL had sent the email confirmation of a delivery to kencko, the company's SC managers were not verifying the items' details checked by the 3PL to see if they were correct according to the original delivery. However, this is a required step since there may be cases where the 3PL's managers make mistakes like forgetting to mention a discrepancy to kencko or incorrectly registering the details of a delivery;
- It had not been established between kencko's SC managers whether or not the deliveries made at the 3PL warehouse already reserved for the external fulfillment warehouse should be registered in the *3PL warehouse* tab, since they would not necessarily be stored there. This scenario led to some of these deliveries being registered while others were not, also contributing to large discrepancies.

4.3 Outbound Logistics Processes at the 3PL Warehouse Before ERP Implementation

For the outbound logistics processes at the 3PL warehouse, the physical and information flows that occur regarding shipments made from it to kencko's fulfillment or in-house packing warehouses will be mentioned. Just like for the inbound logistics processes, a description of these processes according to the pre-ERP scenario will be given, as well as paying attention to the interactions between kencko and the 3PL. Another set of inefficiencies and mistakes occurring during these processes will also be described to show that there is a need for their optimization as well.

4.3.1 Transfer Order from kencko to the 3PL

After analyzing the forecasts on which SKUs are needed to be replenished at the fulfillment and in-house packing warehouses, kencko's Operations managers (for fulfillment) and SC managers (for packing) proceed to inform the 3PL about the need for a future transfer.

For the in-house fulfillment and in-house packing warehouses, kencko's Operations and SC managers usually make these transfer orders during the morning, in order to receive them during the weekday after. For transfer orders with the final destination being the external fulfillment warehouse, it is required for kencko's Operations managers to arrange with another 3PL transportation provider and with the 3PL warehouse provider a specific date and time for the containers to be prepared at the 3PL warehouse for the products' shipment.

These transfer orders are made by filling in the required SKUs, quantities, batch codes and arrival place in the 3PL's online portal and by sending a packing list via email to the 3PL with the same information. kencko's Operations and SC managers then register these transfer orders and their details in the company's Google Sheets documents in a distinguished tab for each warehouse, where they will remain with the *open* status until they have been delivered.

4.3.2 Transfer Order Preparation and Dispatch

After receiving the transfer order from kencko, the 3PL starts by checking in its WMS if the requested items are stored at its warehouse. If, for some reason, a certain item is not available, the 3PL notifies and asks kencko to resend the packing list according to what is available. kencko's SC managers will, in another time, run an investigation over the registered stockout and take action to correct the situation.

After receiving a correct packing list, the 3PL performs the picking process on the same day to be able to dispatch the required items on the weekday after to the in-house fulfillment

and in-house packing warehouses. Therefore, the 3PL is responsible for the loading of the right items and quantities that were asked by kencko for these warehouses.

4.3.3 Transfer Receipt at kencko's Fulfillment and In-house Packing Warehouses

The 3PL delivers the products at the internal fulfillment and internal packing warehouses on the weekday after the packing list has been received, even though it does not have a consistent schedule for when to make these deliveries at kencko's warehouses during that day.

As the 3PL's truck arrives at each warehouse, kencko's warehouse teams unload the pallets with the items and sign a delivery note. After that, the warehouse teams perform a physical check of the SKUs, quantities, batch codes and BBDs in the deliveries made to ensure that they were done correctly. The same process is applied for the deliveries made by the other 3PL transportation provider at the external fulfillment warehouse. After having checked the items received, the warehouse teams store them and report the status of the deliveries to kencko's Operations and SC managers for the two fulfillment warehouses or exclusively to the SC managers for the internal packing warehouse.

If the deliveries made seem to be correct, the Operations and SC managers proceed to register the deliveries in the tabs designated for each warehouse. If the warehouse teams come across discrepancies in the deliveries received, they report the problem to the Operations and SC managers for them to contact the 3PL to understand the root cause of the problem and to fix it afterwards. This may result in the 3PL showing the WMS's recent history or even in a cycle count of the SKU(s) concerned. If there was a picking error from the 3PL warehouse, then both parties register the actual items delivered. If no mistake has been found, kencko may proceed with a stronger investigation and reach an agreement with the 3PL on what to register in both inventory records.

4.3.4 Mistakes Made in the Outbound Logistics Processes

Just like in the inbound logistics processes at the 3PL, it is also possible to find operational gaps that translate into mistakes and inefficiencies that were being committed during the outbound logistics processes by kencko's SC and Operations managers and the 3PL. Furthermore, these mistakes and inefficiencies were also occurring on several occasions and in an inconsistent way, leading to complicated and complex root cause analyses of all those mistakes. These situations were occurring in both the internal documents used by kencko to register the shipments made from the 3PL warehouse and in the processes in which kencko

and the 3PL interacted with each other. The most regular and relevant mistakes and inefficiencies being made were as follows:

- Due to the inconsistent schedule for deliveries made at kencko's internal warehouses during the weekday after the packing list had been sent, kencko's operators at the fulfillment warehouse would, on several occasions, only receive the deliveries at the very end of the day. Since the warehouse operators need a considerable amount of time to check if the deliveries are correct, this situation led to some cases of accumulation of deliveries to be checked and stored. This would, eventually, result in consequences like outdated inventory records in the *Fulfillment* and the *3PL warehouse's* tabs for a few days and rushed delivery checks by the warehouse operators, possibly creating more discrepancies. This situation was also brought up for discussion in the focus group with the 3PL's managers;
- Whenever discrepancies were registered in a delivery made at kencko's warehouses, the Operations or SC managers would not report several of them to the 3PL. This meant that a root cause analysis would not be performed whenever this happened and, in case a mistake had actually been made by the 3PL, it would not be informed about it and would not correct it in its WMS, leaving the system with discrepancies;
- Just like for the inbound processes, the same mistake for deliveries for the external fulfillment warehouse was being made, i.e., some of the shipments made from the 3PL warehouse were not being registered in the *3PL warehouse* tab. As previously mentioned, this would happen because it had not been properly defined whether these shipments containing already reserved items should be registered in the *3PL warehouse* tab or not, which led to some being registered while others not;
- The registering responsibilities in kencko's internal documents were not properly allocated and clear. More specifically, it was not well defined whether it should be kencko's SC or Operations managers recording the outbound movements to the fulfillment warehouses in the *3PL warehouse* tab. This situation led to some outbound movements not being registered or being registered more than once.

That being said, it is important to state that, since there was not proper care given to the inbound and outbound logistics processes at the 3PL warehouse, kencko's SC managers would often take a long time to realize something was not right and that a mistake had been made in the company's inventory records. These situations would usually happen when a SC or Operations manager noticed that the quantities of each SKU registered in the internal documents' *3PL warehouse* tab either had negative values, did not seem to be correct or were different from the inventory records in the 3PL's WMS.

Moreover, since there were lots of mistakes and inefficiencies being committed by kencko's SC and Operations managers and the 3PL, this situation resulted in an accumulation of several distinct discrepancies for a lot of SKUs in the inventory records. To understand how and when these mistakes had happened and who had been responsible for each one, it would be required to perform complex root cause analyses that take a long time and a big effort to be concluded. These root cause analyses would, therefore, not be performed most of the times and several partial counts of the SKUs concerned would simply be requested to the 3PL on a regular basis to solve the existing problems. This situation should be avoided by always performing these analyses to reach a conclusion on the inventory discrepancies. That way, it would allow kencko to understand if the inventory discrepancies detected had simply originated from recording errors or if they may have been related to missing inventory.

To conclude, this scenario of the inbound and outbound logistics processes at the 3PL warehouse showed several flaws and operational gaps, which translated into multiple inventory discrepancies, especially on kencko's perspective. These mistakes and inefficiencies should be corrected or optimized in order to avoid more situations like these in the future and to guarantee more accurate inventory records in regard to the 3PL warehouse. This is based on the fact that, although kencko was certain about its future cloud ERP system strategy for the inventory registering and control, the company had decided that it was still necessary to use the Google Sheets documents, for an undefined period of time, after the ERP had been launched. This decision was made while taking into consideration that some of the company's departments would still be dependent on these documents for a while and that it would be required to prevent any problems or mistakes that may occur with the use of the ERP in the earlier stages that would influence the well-functioning of the registering operations.

4.4 Recording and Tracking of Batch Codes and BBDs

As already mentioned, before the implementation of the cloud ERP, kencko relied on Google Sheets documents to register and track the inventory in the several locations. However, these documents lack important tools and features that allow a correct and more detailed recording of inventory, such as the possibility of registering and tracking the batch codes and BBDs for food items and in a simple and clear way.

Since kencko is a smart food company, the majority of the SKUs it operates with are food items. Thus, in order to guarantee a proper food traceability and safety, it is required to associate to each food item distinguishable batch codes and BBDs. kencko was performing this traceability through an internal document that was solely created for the purpose of knowing which batch codes existed at each moment. This document was detached from the

main inventory recording documents and was not being used to register and track the food items in each location, such as the 3PL warehouse. Furthermore, these documents also did not give insight on any inbound or outbound movements occurring at the 3PL warehouse.

At the same time, the document that was being used to register the inbound and outbound movements at the 3PL warehouse had no information on the batch codes and BBDs of the food items stored or being transferred to and from the warehouse. This was due to the fact that it was a very hard task for kencko's employees to include in the document every batch code and BBD for every food item at all times. This meant that, since the Google Sheets program restricted kencko from adding this information in a simple and clear way, the company, therefore, decided to merely register and track each SKU's quantities at the 3PL warehouse and rely on the information provided by the 3PL's WMS.

This WMS system, that is made available for kencko's employees through an online portal connected to the system, contains all the information regarding the inventory, including the batch codes and BBDs, that is either received, stored or transferred from the 3PL warehouse. So, whenever kencko's employees perform a transfer order request from the 3PL warehouse to the fulfillment or packing warehouses, they have to consult the 3PL's online portal to look at the available batch codes and BBDs to choose from. Therefore, this was an issue for kencko as the company should have its own means to know which batch codes and BBDs are stored at the 3PL warehouse, instead of having to trust the 3PL's WMS inventory records.

4.5 ERP System Implementation

In the year of 2021, kencko came to the conclusion that there was a need to implement an ERP system that would serve as the main tool for the recording and tracking of most of the information regarding the company's SC and order fulfillment operations.

This decision was made based on the fact that kencko had been relying on several Google Sheets documents that had been created and used until this point, instead of having a single centralized system containing all the required information and in a synchronized way. Also, these Google Sheets documents were not interconnected with each other and lacked several important tools and features that allow to properly register and track all the inventory in the several locations, which made it very complicated for kencko to keep every document well structured, organized, updated and in accordance with each other. Additionally, unlike the ERP, the Google Sheets documents require a greater effort from kencko's employees to create and to manage all the necessary formulas and functions that allow the documents to be

operational and help perform the required actions, making this another reason for possible discrepancies and errors that may occur.

In terms of the tools and features that an ERP would offer and which the Google Sheets documents lack, the first example is the ability to register and track in an easy and clear way the batch codes and BBDs associated with each food item that is recorded in the system. This already mentioned problem was one of the key reasons for kencko to make this transitioning decision in order to gain more visibility on the inventory's information and details, instead of depending on the 3PL's inventory records to access them. Also, the ERP includes important features that help to guarantee less mistakes being made by kencko's employees during the registering activities for the 3PL warehouse and, therefore, reducing the number of inventory discrepancies in the inventory records of the company. Some examples of these features are the inability for kencko's employees to discount quantities of an SKU from the 3PL warehouse that have not been added to it beforehand and the overall simplification of the registering and tracking processes through automated actions.

That being said, after taking care of the preparations for the cloud ERP implementation, kencko performed a physical count of all the inventory stored in each location to update the ERP on the day after with the correct items' information and subsequently initiate its use. This physical count was performed on the 16th of February of 2022, although there had been another one on the 26th of January of the same year that resulted in a failed attempt to launch the ERP system. On the day of the official physical count, kencko initiated a frozen period when all operations were stopped in each location, including the 3PL warehouse, to guarantee that there would not be any misunderstandings regarding the items moved or utilized in these operations during this period. After having successfully performed this action, kencko began registering all SC and fulfillment operations in the ERP on the 17th of February and simultaneously in the Google Sheets documents, still keeping in mind that the final goal would be to exclusively use the ERP for these actions once it was possible. Thus, a part of this research project will involve facilitating the ERP launch by helping to perform the registering activities for the inventory movements at the 3PL warehouse.

However, after the launch of the ERP system, it was also important to guarantee that this new system and its tools and features would be properly understood and correctly used during the registering activities of the inventory that goes through the 3PL warehouse. One way of guaranteeing this aspect would be by documenting the procedures in which the several steps for the inbound and outbound logistics processes would be described according to the new cloud ERP instead of the Google Sheets documents.

4.6 kencko's Documentation on 3PL Processes

As previously mentioned, there was a big lack of documentation on the several processes that occur between kencko and the 3PL, like the inbound and outbound inventory logistics and some other relevant operations in regard to inventory control. The only document containing some information on the actions performed by kencko and the 3PL was the original contract signed by both, but it also did not mention several steps and details. The insufficient documentation made it difficult for kencko's employees to have a clear idea of the processes and actions of physical and information flows to be performed by the company and the 3PL.

This lack of understanding from kencko's employees led to the previously described situation of several operational gaps that translated into mistakes and inefficiencies being committed by kencko and the 3PL during their interactions, creating a need for optimization of the processes. This situation soon became similar to the context of kencko working with the previous 3PL warehouse provider, which translated into kencko's inability of: properly registering the inventory movements at the 3PL warehouse; having correct and updated inventory records on a regular basis; and, in turn, being able to tell if the 3PL's inventory records were also correct or not.

That being said, to correct this situation, it was decided that detailed standard procedures had to be developed to guarantee that kencko's employees would follow the several steps and perform the actions described in them in regard to the 3PL warehouse. Additionally, it was decided that these procedures would also include the processes performed at the 3PL warehouse by its managers and operators as it would be important for kencko's employees to have a general view and to understand them as well. This information on the 3PL's internal actions will be gathered from the 3PL contract and the focus group with the 3PL's managers mentioned in the methodology chapter.

Although kencko had not created the procedures for this topic yet, the company had already developed a procedure template that would serve as the basis for the development of any procedures from the several departments in the company. Therefore, in a sequential order, this procedure template consists of:

- A *Purpose*, where the rationale of the procedure is explained;
- A *Scope*, which names the departments of the company that are affected by the procedure;
- *Associated Documents and References* that support the procedure;

- *Definitions* of important words and terms used in the procedure that may help the readers;
- *Responsibility*, i.e., the identification of who is included in the procedure and what they are required to do;
- The *Procedure*, which is where the processes, steps and actions of the procedure are identified and explained;
- And the *Document Version Control*, where eventual changes that occur after having published the procedure are mentioned.

Taking this pre-established procedure template and after discussing with the company's SC managers about which processes should be documented and described, the conclusion was to develop four related procedures for processes containing interactions between kencko and the 3PL warehouse. These procedures, in turn, consist of important processes that are described through several steps with actions performed by both kencko's and the 3PL's employees. The main objective of these procedures is for readers to understand the whole image of the performed operations, including the ones performed by the 3PL. These four procedures will be named and described in the Implementation chapter of this paper.

However, after discussing with kencko's SC managers, a decision was made on an additional category being created in the established template for these procedures. This new category is, therefore, called *Possible Mistakes and Root Causes for Inventory Discrepancies*, which was placed after the *Procedure* category. This new category, which was based on the performed literature review, serves to mention several moments in the processes described that could lead to mistakes or inefficiencies being committed by kencko's or the 3PL's employees. These situations could eventually become the root causes for inventory discrepancies in both kencko's and the 3PL's inventory records. By listing these aspects, it allows kencko to be more aware of them and to pay more attention and care when these processes' actions are being performed, either by kencko or the 3PL, to avoid as many mistakes and discrepancies as possible.

Furthermore, during the discussion with kencko's SC managers, one topic arose regarding the registering system/documents for the inventory movements occurring at the 3PL warehouse. More specifically, this topic was about whether the procedures should be developed according to the use of the Google Sheets Documents or to the newly implemented cloud ERP system. Thus, it was decided that the procedures for the processes should be exclusively developed according to the use of the ERP system by kencko's employees during them. The justification for this decision was about the long-term goal of the company being to

stop using the Google Sheets documents once the ERP system was being perfectly used and the Google Sheets documents had no more use.

4.7 Measurement of the 3PL's IRA Performance

When it comes to tracking the 3PL's performance regarding its processes, there were some KPIs already established in the contract in order to evaluate the service level given by the 3PL to kencko. Although these KPIs give a general view of the 3PL's service level, they were not sufficient for kencko's SC managers to perform a proper evaluation of the accuracy of the 3PL's inventory records. Since kencko had not established any additional KPIs to track the 3PL's recording accuracy, it was discussed with the SC managers about the possibility of implementing more metrics with the goal of having a more complete view on this matter. Thus, the decision was to look for, choose and implement new KPIs that would give the opportunity to analyze the 3PL's IRA performance in great detail and to gather enough information on possible mistakes made in the registering process by the 3PL. Through this, kencko would not only be able to evaluate the accuracy level of the 3PL's inventory records, but also to perform root cause investigations and reach credible conclusions on each mistake found to take any necessary actions if required.

4.8 Measurement of kencko's IRA Performance

Although it was important for kencko to properly evaluate the 3PL's performance on its inventory recording, the primary concern for the SC managers was for them to also be able to evaluate kencko's own IRA for the 3PL warehouse. The reason for this concern from kencko is related to the previously mentioned problems regarding kencko's inventory records, i.e., the several mistakes committed on a regular basis whenever inbound or outbound logistics processes would take place at the 3PL warehouse, leading to significant discrepancies and inaccurate results.

During the discussion with the SC managers, it was decided that this self-evaluation would be performed for the Google Sheets documents to evaluate the effectiveness of the changes and corrections made in the registering process. Moreover, it was also decided that one of the requirements for this self-evaluation would be to perform it to the newly implemented cloud ERP system as well to examine the registering performance in it. That being said, through this self-evaluation, kencko would also have a detailed view on how close the company's inventory records are to reality and, therefore, examine how reliable they are for consultation and for the basis of the company's routine and strategic operations regarding the 3PL warehouse.

Furthermore, it will only be possible to evaluate the veracity of the 3PL's inventory records if kencko also had its own inventory records as close to reality as possible in order to compare both of them.

With that said, in order to facilitate both the analyses of kencko's and the 3PL's IRA performances, it was decided that it would be more beneficial to implement the same KPIs for each one and, therefore, perform a similar and clear analysis that allows to easily compare both results. The two chosen KPIs and their evaluation process will be described below.

4.9 SKU Integrity - IRA KPI

The first KPI to be mentioned for the IRA regarding the inventory at the 3PL warehouse is the SKUI. According to the literature review, this performance metric will be considered as the percentage of counted SKUs that match their records, in terms of quantities, from the total number of counted SKUs. For this analysis to be performed, a physical count of all the SKUs stored at the 3PL warehouse is required in order to compare the results with their inventory records. Another possibility for this measurement would be to perform cycle counts, in several occasions, of portions of the SKUs stored at the 3PL warehouse and carrying out the SKUI check for the counted SKUs at each of those cycle counts. That being said, the formula for this metric is as follows:

$$SKU\ Integrity\ (\%) = \frac{Number\ of\ Accurate\ SKUs}{Total\ Number\ of\ Counted\ SKUs} * 100 \quad (1)$$

For this metric, it was decided, along with kencko's SC managers, not to establish a tolerance for any size of registered discrepancies since the second metric will be more appropriate for the analysis of this aspect. That being said, during this analysis, a SKU's record is considered accurate if it perfectly matches the quantities counted. After getting the results from the inventory count(s), the accuracy calculations of each SKU are performed by using the previously mentioned equation, for both the 3PL's WMS records and for kencko's Google Sheets documents and ERP system's records as well. To conclude, the goal to be achieved for this metric should be as close as possible to a perfect result of 100%.

4.10 Absolute Deviation - IRA KPI

The second KPI being considered for the measurement of the IRA in terms of the 3PL warehouse is the AD. For the analysis of this KPI, it is also required to perform a physical count

of all the SKUs stored at the 3PL warehouse or cycle counts of portions of them to compare the results with their inventory records. Despite being related to the previous performance metric, the AD KPI, according to the literature review, can be seen as being more flexible as it gives details on the scale of discrepancies detected and, in turn, the scale of accuracy. Besides the AD percentage formula, the equation for the opposite IRA percentage will also be described. The formulas for this KPI are shown below:

$$\text{Absolute Deviation (\%)} = \frac{|\text{Counted Units} - \text{Record Units}|}{\text{Record Units}} * 100 \quad (2)$$

$$\text{IRA (\%)} = 100 - \text{Absolute Deviation} \quad (3)$$

After receiving the results from the inventory count(s), the calculations, with the use of these formulas, are performed for the 3PL's WMS records and for kencko's Google Sheets documents and ERP system's records. That being said, the formulas will be applied to each counted SKU separately to reach the AD and accuracy percentages that tell how distant or close the SKUs' units are in the inventory records to the results of the inventory count(s). At the end, a final calculation will be performed for the sum of the absolute value of all SKUs' deviations to reach a total AD and accuracy percentages. This calculation will give a general and clearer view of the performances of the recording activities of the mentioned inventory records. For this KPI, it was established, with the help of kencko's SC managers, a 2% tolerance in regard to each SKU's registered discrepancies, as well as for the sum of all SKUs' discrepancies. This means that, in order to consider the counted SKUs as being accurate, none of the AD results should be above this percentage limit. Also, this tolerance limit may also serve as guidance for kencko's SC managers to decide on whether or not to perform root cause analyses for the detected discrepancies, depending on the result of the ADs. Furthermore, there are some assumptions to be made regarding specific scenarios that have to be considered prior to the formula's calculations:

1. If a SKU's record units and the counted units are both equal to 0, the AD is equal to 0% and the inventory record is 100% accurate;
2. If the record units of a SKU are equal to 0 while the counted units are different than 0, the AD is equal to 100% and the inventory record is 0% accurate;
3. If a SKU's record units are negative due to inappropriate recording operations, they will be considered as being equal to 0 in the AD formula since, realistically speaking, there is no negative inventory. However, the SKU concerned will have a 100% AD score and its inventory record will be 0% accurate.

Chapter 5: Implementation

For the implementation component of this project, the corrective actions performed to solve kencko's main problem regarding the 3PL warehouse will be presented, i.e., the lack of optimization and documentation of the logistics processes between kencko and the 3PL and the inability of evaluating both parties' performances regarding the recording of the inventory stored at the 3PL warehouse. More specifically, these performed actions will be described with the purpose of showing how an optimization of the processes regarding the 3PL warehouse was reached by fixing operational gaps, according to the contexts of the Google Sheets documents and the cloud ERP system.

5.1 Corrections Made for 3PL Inbound Logistics Processes

Taking into account the previously described context, there were important corrections and adjustments made still in the Google Sheets documents scenario used by kencko and some actions performed by the 3PL during the inbound logistics processes. These corrections, therefore, contributed to a better accuracy of kencko's inventory records for the 3PL warehouse. Following the order of the mistakes and inefficiencies that were listed in the previous chapter for the inbound logistics processes, the corrections made for each one will be described below.

When it came to the 3PL's request from the focus group performed in regard to the registration of future deliveries on its online portal, this message was reinforced to kencko's employees and all deliveries started being correctly registered and notified on time and no issues or misunderstandings regarding these aspects have occurred since then.

In terms of the *OTW* tab from the Google Sheets documents that was not being used, the decision made was to start constantly using it by registering all future deliveries at the 3PL warehouse in this tab with the *open* status until having been delivered. This change ultimately gave a safety step and helped fixing the problem regarding the uncertainty of deliveries having been registered or not in the *3PL warehouse* tab. Also, the *OTW* tab is now useful for kencko's SC managers to be more aware of cases where the 3PL might forget to notify kencko about the arrival of a certain delivery.

When it comes to the 3PL forgetting to notify kencko via email about a received delivery, after bringing up this topic in the focus group performed and explaining its importance, the 3PL's managers have started performing this step every time a delivery is registered in their WMS and at an appropriate time, allowing kencko's SC managers to never miss the registration of a delivery due to this mistake from the 3PL's managers.

In terms of letting kencko know about certain delivery discrepancies, after discussing this subject in the focus group performed, the 3PL's managers started paying more attention in this regard, which led to all discrepancies being shared with kencko's SC managers.

Regarding the information received from the 3PL about the items' details of a delivery received, it was reinforced to kencko's SC managers the need to always verify these details before registering the deliveries in the *3PL warehouse* tab and marking them as *closed* in the *OTW* tab. With this implemented step, any registered discrepancies may now be detected right away by kencko's SC managers, eliminating inventory record inaccuracies derived from this case and the necessity of performing root cause analyses in this regard.

After discussing with kencko's SC managers, the conclusion made regarding deliveries made at the 3PL warehouse already reserved for the external fulfillment warehouse was to start registering all of them in the *3PL warehouse* tab. This decision was made not only to guarantee consistency in this case, but also to give a better traceability of these items at each moment. After making this decision, no more discrepancies originated from this case.

5.2 Corrections Made for 3PL Outbound Logistics Processes

For the outbound logistics processes' context, there were also important corrections and adjustments implemented in the Google Sheets documents scenario used by kencko and in some actions performed by the 3PL during these processes. These corrections also contributed to kencko having a higher IRA regarding the 3PL warehouse. The corrections or adjustments made for each mistake or inefficiency listed in the previous chapter will now be presented by following the same order.

In the focus group with the 3PL's and kencko's managers, the situation of some deliveries being made at the end of the working schedule at kencko's warehouses was brought up by explaining how it complicated the storing process for kencko's warehouse operators. The 3PL's managers responded by saying they would talk to their warehouse and transport operators to see if they could deliver the items earlier more often. The answer from the 3PL's operators was positive and that they would perform the deliveries earlier during the day whenever possible.

For the problem related to discrepancies being found by kencko's warehouse operators whenever deliveries are made from the 3PL warehouse, the correction made was to reinforce the need to always report these incidents to the 3PL and to perform a root cause analysis. Since then, every time kencko's warehouse operators have found and reported a discrepancy, the SC and Operations managers have always contacted the 3PL's managers to reach a

conclusion about the situation and to make any corrections if necessary. This correction, therefore, contributed to more accurate inventory records from both kencko's and the 3PL's perspectives whenever these deliveries would take place.

Just like for the inbound movements, after discussing with kencko's SC and Operations managers about the shipments of reserved items from the 3PL warehouse to the external fulfillment warehouse, the decision was to always register them in the *3PL warehouse* tab. By making this decision, the registration of these dispatches became consistent and allowed a better traceability of these items at all times. Since then, no more discrepancies have originated from this case.

For the allocation of the process of registering the outbound movements to the fulfillment warehouses in the *3PL warehouse* tab, after discussing with kencko's SC and Operations managers, it was decided that the Operations managers would be exclusively responsible for it. In turn, this decision eliminated a considerable level of confusion between both departments' managers about this responsibility. Practically speaking, it eliminated discrepancies in kencko's inventory records derived from this particular process.

5.3 Procedures' Development for 3PL Warehouse Processes

In the previous chapter, it was described the context of the lack of documentation on the inbound and outbound logistics processes and some others regarding inventory control at the 3PL warehouse. It was then decided that four distinct but also related procedures would be developed, according to the ERP system, in order to fulfill this need. The development of these procedures included all the mentioned and established categories in the previous chapter. That being said, the developed procedures that will be subsequently described are as follows: *3PL Inbound Logistics Processes*; *3PL Outbound Logistics Processes*; *Inventory Count at 3PL Warehouse*; and *IRA Measurement - 3PL Warehouse*.

5.3.1 3PL Inbound Logistics Processes and 3PL Outbound Logistics Processes Procedures

The *3PL Inbound Logistics Processes* (see Appendix A) and *3PL Outbound Logistics Processes* (see Appendix B) procedures were both reviewed and approved by kencko's SC managers on the 15th of March of 2022. Generally speaking, these procedures mention the several physical and informational actions performed by kencko's SC and Operations departments, consisting of their managers and warehouse operators, and also by the 3PL's

managers and warehouse operators during the inbound and outbound logistics processes. The two procedures, therefore, describe these actions in a detailed way and in accordance with the new ERP system for kencko's employees to clearly learn how to perform them, as well as to understand the actions performed by the 3PL. The *Possible Root Causes for Inventory Discrepancies* category in each of these procedures lists several root causes for discrepancies in both processes that negatively affect the IRA regarding the 3PL warehouse, as well as the locations where the items are dispatched to from the warehouse.

5.3.2 Inventory Count at 3PL Warehouse Procedure

The *Inventory Count at 3PL Warehouse* procedure was reviewed and approved by kencko's SC managers on the 18th of April of 2022 (see Appendix C). This procedure mentions the several actions performed by kencko's SC managers and by the 3PL's managers and warehouse operators in regard to the process of performing a physical count of the whole inventory or cycle counts of certain amounts of SKUs stored. It was also established, along with kencko's SC managers, a standard periodicity for cycle counts to be performed, including the number of SKUs checked in each one, in order to continuously monitor and have a general idea of the status of the inventory records. Moreover, the *Possible Root Causes for Inventory Discrepancies* category mentions some moments where mistakes could be made by kencko's SC managers or the 3PL which may negatively affect the inventory counts and their results.

5.3.3 IRA Measurement - 3PL Warehouse Procedure

The *IRA Measurement - 3PL Warehouse* procedure was also reviewed and approved by kencko's SC managers on the 18th of April of 2022 (see Appendix D). The procedure starts by describing some situations that trigger the process of performing these evaluations. Then, it proceeds to describe the sequential approach of the actions to be performed for the calculations of the SKUI and AD KPIs and in accordance with the new ERP. After that, the action steps for root cause analyses, according to the established 2% tolerance for the AD of the detected inventory differences, were described. Also, a two-week maximum period was implemented for conclusions to be reached from the root cause analyses. Additionally, it was established in this procedure the necessity of performing the monitoring of the inventory records once every two weeks by comparing the 3PL's and kencko's inventory records to avoid an accumulation of several inventory discrepancies. Finally, the *Possible Root Causes for Inventory Discrepancies* category contains the same causes as the ones presented in the *3PL Inbound Logistics Processes* and *3PL Outbound Logistics Processes* procedures, which will

help to perform the root cause analyses of the inventory discrepancies detected through these calculations.

5.4 IRA Measurement - SKU Integrity and Absolute Deviation Analyses

For the IRA calculations and evaluation, the results from three physical counts performed of all the inventory stored at the 3PL warehouse were used. The first two inventory counts, performed on the 26th of January of 2022 and the 16th of February of the same year, had already been performed in the context of the ERP implementation, as previously mentioned. Additionally, after discussing with kencko's SC managers, a third physical count was performed on the 5th of May of the same year in the context of performing the IRA measurement. The intention of performing this physical count was, therefore, to evaluate the current situation regarding kencko's and the 3PL's performances on the recording of the inventory movements with the goal of having accurate inventory records. Moreover, the results from the third physical count will allow to evaluate the impact of the corrective actions made for the Google Sheets documents on this matter and the impact of the ERP system and the developed procedures according to it, when comparing the results to the IRA status at the first two physical counts.

Going into detail, the SKUI and AD KPIs were first put into action by performing their calculations with the results from the first two physical counts, along with the 3PL's WMS and kencko's Google Sheets documents. For the third physical count, the KPIs' calculations were performed along with the 3PL's WMS and kencko's Google Sheets documents and ERP system. The results of both KPIs' measurement for the three physical counts will now be presented according to each inventory record's system.

5.4.1 3PL - WMS's IRA Performance

Overall, the 3PL's WMS had an adequate performance regarding the two IRA KPIs in all three physical counts, with a considerable increase in the SKUI metric when comparing the first physical count to the other two. For the AD, the 3PL's WMS registered consistent and satisfying results in all three counts by never exceeding the established 2% tolerance for the total result of this metric, since all three total results were below 1%. The results of the comparison made between the physical counts and the 3PL's WMS inventory records are described below:

In the first physical count (see Appendix E), the 3PL registered in its inventory records 65 accurate SKUs out of the existing 73 that could be stored at the 3PL warehouse at that time, meaning that the SKUI was equal to 89,04%. Also, it was registered a total AD of 0,68% of all SKUs and, consequently, a total 99,32% of IRA score. However, the worst SKU score was 100,00% away from being completely accurate;

In the second physical count (see Appendix F), the 3PL had 71 correct SKUs in the inventory records out of the existing 73, which translates into a SKUI of 97,26%. Additionally, the 3PL registered a total 0,01% of AD and a 99,99% IRA of all SKUs, while the least satisfying SKU result was 0,13% away from being completely accurate;

In the third and final physical count (see Appendix G), the 3PL registered 78 accurate SKUs in the inventory records out of the existing 79 that could be stored at the 3PL warehouse at that time, meaning that the SKUI was equal to 98,73%. Moreover, the 3PL registered a total AD of 0,03% and, therefore, a 99,97% IRA score of all SKUs, although the least satisfactory SKU score was 09,62% away from being completely accurate.

5.4.2 kencko - Google Sheets Documents' IRA Performance

As already mentioned, the problem of correctly recording the inventory at the 3PL warehouse was more significant on kencko's side, rather than the 3PL itself. With that said, by analyzing the results from the physical counts at the 3PL warehouse, kencko had, generally speaking, a significant and satisfying increase in performance regarding the two established IRA KPIs from the first physical count to the last one. The results of the comparison between the physical counts and kencko's Google Sheets documents are described below:

In the first physical count (see Appendix H), kencko registered in the inventory records 38 accurate SKUs out of the existing 73, which translates into a SKUI of 52,05%. Furthermore, kencko registered a total AD of 31,56% of all SKUs and, consequently, a total 68,44% IRA score, while the worst SKU result was 2253,57% away from being completely accurate;

In the second physical count (see Appendix I), kencko had, once again, 38 correct SKUs in the inventory records out of 73, meaning that the SKUI was equal to 52,05%. Additionally, kencko registered a total 34,06% of AD and a total 65,94% IRA of all SKUs, while the least satisfying SKU score was 100,00% away from being accurate;

In the third and last physical count (see Appendix J), kencko registered in the inventory records 63 accurate SKUs out of the existing 79, which translates into a SKUI of 79,75%, a significantly higher result compared to the other two. Also, kencko registered a total AD of

0,95% of all SKUs, meaning that it did not exceed the previously established 2% tolerance limit, unlike the previous two results that had much higher results. Thus, this last physical count had a 99,05% IRA score, although the least satisfying SKU score was 62,50% away from being completely accurate.

5.4.3 kencko - ERP System's IRA Performance

When it comes to the ERP system, kencko's main concern was to see how its use would help with the registering processes for the inbound and outbound logistics movements in the several locations, including the 3PL warehouse. Since the third physical count was the one performed after the ERP implementation, its results will be used to analyze the performance regarding the IRA of the ERP. Moreover, this analysis will include, besides the quantities' check, the batch codes' accuracy of each SKU stored at the 3PL warehouse, since one of the initial desires from kencko when implementing the cloud ERP was to be able to register and track the batch codes of the food products stored in each location.

On the one hand, regarding only the SKUs' recorded quantities, the IRA results show great similarity between the ERP and the Google Sheets documents used for the recording operations of each SKU stored at the 3PL warehouse (see Appendix K). In fact, in the ERP system, there were only two different SKU results from the Google Sheets documents and which got a perfect score in the two IRA KPIs. Thus, in regard to the SKU quantities, there was a slight increase registered in the total results of the IRA metrics for the ERP system. For the SKUI, the ERP had an 82,28% IRA score, with 65 correct SKUs out of the existing 79. The ERP also registered a total 0,92% of AD of all SKUs and, consequently, a total 99,08% IRA score.

On the other hand, in terms of the batch codes and respective quantities of the several food products, the ERP results were satisfactory for kencko's SC managers as the registered batch codes of the products at the 3PL warehouse were, from a general point of view, accurate according to the actual batch codes checked (see Appendix L). Going into detail, from the 53 batch codes checked in the physical count, there were only four inventory record discrepancies encountered regarding their quantities, which can be grouped into two errors: the first error was related to 6.5 thousand units of a certain SKU that were added to one of its existing batch codes instead of a new one being created in the ERP; the second and final error was related to one thousand units of a SKU that were added to one of its batch codes instead of another existing one, meaning that none of the food product quantities were actually affected.

For an overall view, by taking the SKUI formula and applying it to the batch codes, i.e., dividing the 49 correct batch codes by the total 53 checked, a 92,45% accuracy score is obtained from the ERP. To conclude, thanks to an overall correct recording of the SKUs' batch codes, the ERP became a useful and reliable source of information for the tracking of these food products, eliminating the necessity of consulting the 3PL's WMS for this action.

5.4.4 Root Cause Analyses of Detected Discrepancies

By following the description of the steps in the *IRA Measurement - 3PL Warehouse* procedure, root cause analyses of the differences detected between kencko's and the 3PL's inventory records and the physical count on the 5th of May of 2022 were performed. These root cause analyses consisted of looking into each SKU's inbound and outbound movements' history that had discrepancies, starting from the day of the second physical count until the day of the third one. This process was performed by analyzing the emails exchanged between kencko and the 3PL and the actions performed on the 3PL's WMS and kencko's documents and cloud ERP, regarding the SKUs concerned.

After having concluded these analyses, the conclusion made regarding the detected discrepancies in kencko's inventory records is that only recording mistakes took place in all these cases due to human error. More specifically, all these discrepancies were due to occasional situations where the items received at or transferred from the 3PL warehouse had not been registered or had been registered in the wrong amounts. Moreover, the only discrepancy detected on the 3PL's WMS, which was also in kencko's inventory records, had originated from a registering error in the second physical count performed.

After correcting each discrepancy in kencko's Google Sheets documents and ERP system with the correct quantities, the final result for each SKU was equal to the amounts from the physical count. The same correction was also made on the 3PL's WMS by its managers and the same result was reached. To conclude, the root cause analyses performed on kencko's and the 3PL's inventory records were considered successful, i.e., the root causes for all the detected discrepancies were found and were not related to missing inventory or from misinterpreting the implemented corrective actions, but rather due to recording errors.

Chapter 6: Conclusions, Limitations & Recommendations

In this chapter, general conclusions on this research project will be made in regard to the corrective actions implemented to solve the research problem and to reach the research aim by successfully fulfilling the established objectives for this project. Thus, these conclusions will serve to explain how important and valuable these corrective actions were for kencko's overall operations in regard to the 3PL warehouse, which plays an important role as it is where the big majority of kencko's inventory is stored. Additionally, this chapter will mention some limitations to the research project that need to be highlighted since they influence the research results. Also, these limitations will serve as a link to make recommendations for kencko to further optimize its operations regarding the 3PL warehouse by performing more investigations and developments. To conclude, this research project will also bring academic value to the areas of Warehouse and Inventory Management as it serves as an example of practical applications that strengthen these areas and it includes a literature review to support the research findings.

6.1 Conclusions

This research project consisted of solving problems related to operational gaps and a lack of optimization and documentation of the processes and interactions that occur between kencko and its 3PL warehouse provider, as well as the evaluation of both parties' inventory recording performances. The methodology used played an important role in this research project as it allowed to gather and analyze important and useful data and information that were used to reach the established research objectives. All the actions, mentioned below, that were performed to solve the research problem contributed to the last component of the research project, which was the results from the IRA measurement at the final physical count.

Firstly, after analyzing all the activities performed by kencko's SC and Operations departments and the 3PL's managers and operators that constitute the inbound and outbound logistics processes at the 3PL warehouse, a considerable number of problems were identified. These problems, which already existed in the pre-ERP scenario through the use of Google Sheets documents, translated into mistakes and inefficiencies that were occurring in several moments throughout these processes. These situations, in turn, negatively influenced the well-functioning of the operations, being kencko's inaccurate and unreliable inventory records the most worrying consequence. So, in the implementation phase of this research project, several corrections were successfully made in this regard to eliminate these mistakes and

inefficiencies that were occurring on a regular basis, allowing a better inventory tracking and control in regard to the 3PL warehouse.

Secondly, another component of this research project was related to kencko's new cloud ERP system and the need to facilitate its launch in terms of the registering activities for the inbound and outbound logistics processes at the 3PL warehouse. After the preparations for the ERP launch, including the physical count performed in the 3PL warehouse, the registering activities began on the 17th of February of 2022. In order to correctly perform these activities, the ERP user guide and tutorial videos were analyzed beforehand, as well as the information received from interviews with the SC and Operations managers in this regard.

Thirdly, in terms of kencko's need for documentation on the processes around the 3PL warehouse, this research project also allowed to fulfill this by developing four distinct but related procedures for this topic. These procedures created value for kencko as they now allow any reader, such as new and current employees, to easily gather information and understand the processes performed or to consult whenever questions or doubts may arise. Also, the development of these procedures ended up being another aspect that facilitated kencko's transition to the ERP as these procedures were all developed according to the actions to be performed in the system. The *3PL Inbound Logistics Processes* and *3PL Outbound Logistics Processes* procedures were crucial to document the main operations that occur regarding the 3PL warehouse, which are the inbound and outbound movements of the inventory. Moreover, the *Inventory Count at 3PL Warehouse* and *IRA Measurement - 3PL Warehouse* procedures are interconnected and they both play important roles in the description of the evaluation process of kencko's and the 3PL's IRA performances, through the steps on how to gather the information and to reach the final performance results.

Finally, the IRA measurement was the last crucial component of this research project as it allowed the 3PL's and kencko's evaluation on this matter. For the 3PL, the IRA calculations served to evaluate the overall service level provided to kencko in this regard, showing very satisfying results for kencko's SC managers. For kencko, these calculations allowed a self-assessment to be made on the accuracy and reliability of the company's inventory records from the Google Sheets documents, in all physical counts, and from the ERP in the last physical count. Moreover, these IRA's self-assessments allow to compare kencko's performance around the time of the first two physical counts, prior to the corrective actions, with the company's performance in the last count performed. That being said, this comparison shows the important impact that all the corrective actions implemented had in kencko's processes related to the 3PL warehouse. There was a very satisfying increase registered in kencko's IRA from the time of the first two physical counts to the last one performed, making

the company's inventory records reliable for the well-functioning of the company's routine and strategic operations, according to kencko's SC managers.

6.2 Limitations

In terms of limitations to this research project, there are some characteristics of the methodology in regard to the available information or the work to be performed that, although not considered for this project, influence the research results.

For example, during this research project, it was not possible to attribute a level of frequency and impact that each type of mistake committed during the inbound and outbound movements at the 3PL warehouse had on the accuracy of kencko's inventory records, even though it was clear that each situation had its distinct relevance.

Another example is related to the human error variable that is always present throughout any routine operations of a company. Also, it is important to take into account that, for the inventory movements at the 3PL warehouse, there were several kencko's employees performing activities assigned to them that were not possible to control at all times to guarantee that they were always successfully performed. With that said, the registered discrepancies in the last physical count were from the recording process due to human error that were not possible to be avoided.

6.3 Recommendations

In terms of managerial implications for kencko, it is recommended that the company makes a continuous effort to control the inventory stored at the 3PL warehouse and to further improve the operations by analyzing the previously mentioned limitations. It is important for kencko to properly perform all the operations for the 3PL warehouse in accordance with the corrective actions implemented in this research project and to progressively reduce the number of discrepancies. Also, it is advised to the SC managers to continuously evaluate the 3PL's performance regarding inventory management, not only including the IRA measurement but also other elements like the picking accuracy and the delivery times. This evaluation is crucial to guarantee that a long-term relationship can be established and to avoid unsatisfying situations like the ones previously experienced with the other 3PL warehouse provider. Finally, the developed procedures in this research project may serve as a basis for the development of new procedures related, or not, to the 3PL warehouse context.

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Appendices

Appendix A

3PL Inbound Logistics Processes Procedure

kencko	3PL Inbound Logistics Processes	SC-P01.01
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1. Purpose

The purpose of this document is to explain in detail how the processes regarding the inbound logistics (receptions) of food products, packaging and packing items, accessories and any other goods requested by kencko to be delivered at the 3PL (third-party logistics) warehouse occur, as well as to mention all the existing interactions and information flow between kencko and the 3PL related to these processes.

2. Scope

This document intends to be an important procedure for the Supply Chain (SC) team, focusing on Inventory Management. This procedure has also an impact on the Operations team.

3. Associated Documents and References

kencko's Enterprise Resource Planning (ERP) System;
The 3PL's online portal / Warehouse Management System (WMS);
3PL Extensive Guide - Inbound & Outbound Logistics Processes;
Inbound Logistics Processes at 3PL Flow Chart;
IRA Measurement - 3PL Warehouse Procedure.

4. Definitions

Term	Description
3PL (Third-party Logistics) Service Provider	A 3PL service provider offers outsourced logistics services, which include any type of management of procurement, warehousing, distribution or fulfillment processes.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Inbound Logistics Processes	SC-P01.01
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Inbound Logistics Processes	The processes and actions involved in the movements of raw materials, finished goods, packaging items, and other supplies received at a certain location (eg.: warehouse; fulfillment center) from, for eg., a manufacturer or other distribution channels.
Information Flow	Relevant information exchange between systems and people for the effective functioning of processes, for eg., in the supply chain.
ERP - Enterprise Resource Planning System	System that automates and supports several operational and administrative business processes across various industries.
WMS - Warehouse Management System	An enterprise software application that automates and manages the processes of an organization's warehouse.

Table 1 - Definitions

5. Responsibility

kencko's SC managers should follow the established protocols in the contract with the 3PL regarding the processes to be performed for the inbound logistics at the 3PL warehouse.

kencko's SC managers are responsible for continuously registering and verifying in the ERP the inbound logistics movements of all products at the 3PL warehouse.

The **3PL** is also obligated to follow the established protocols in the contract signed along with kencko regarding the processes to be performed for the inbound logistics of products, including both physical and information flows.

The **3PL** is responsible for continuously having its WMS updated throughout these inbound logistics processes to guarantee a high level of inventory record accuracy and, in turn, to allow kencko's managers to analyze the inventory levels at the 3PL warehouse through the online portal (read *IRA Measurement - 3PL Warehouse* procedure).

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Inbound Logistics Processes	SC-P01.01
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6. Procedure

1. kencko's SC managers analyze each SKU's production forecast and establish the production with the suppliers and the packing process with the co-packer and the in-house packing;
2. kencko's SC managers wait for a delivery date confirmation from suppliers, while the packing warehouse team arranges the transportation with another 3PL transportation provider;
3. kencko's SC managers register these future deliveries at the 3PL warehouse in the ERP by creating the *purchase orders* (suppliers and co-packer) or *production plans* (in-house packing) with the items' information: SKUs, quantities, batch codes, best-before-dates (BBDs), places of origin and arrival and the expected delivery date;
4. kencko's SC managers notify the 3PL about these future deliveries by generating an email through the ERP with the required information of the delivery automatically filled in by the system and sending it to the 3PL;
5. kencko's SC managers also register these future deliveries in the 3PL's online portal, in the *Deliveries* category, with the previously mentioned information;
6. The 3PL's managers analyze both the email received and the delivery update in their WMS to confirm if the information is in order;
7. The 3PL's operators receive, unload, and count the pallets delivered at the warehouse:
 - a. If the number of pallets is correct and there are no exterior damages, the warehouse operators move to the next step;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Inbound Logistics Processes	SC-P01.01
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- b. In case of missing pallets or exterior damages, the 3PL asks kencko for instructions on how to proceed after unloading the delivery and kencko's SC managers, eventually, perform a root cause analysis with the origin site;
8. The 3PL's operators identify each pallet by labeling them with a barcode and perform an inventory count of the items on those pallets by adding them to their WMS;
9. The 3PL's operators mark the delivery as having been completed in the WMS:
 - a. If the WMS warns about discrepancies in the delivery, the warehouse operators perform a recount on the SKU or SKUs concerned and register what was recounted;
 - b. If no warning is shown, the system marks the items as being ready for storage and available for future transfer orders;
10. The 3PL's operators store the pallets in the warehouse according to WMS's storage indications;
11. Once stored, the WMS updates the status of the deliveries from being on-the-way to being already stored and the 3PL managers send this information to kencko via email;
12. kencko's SC managers compare the registered items by the 3PL with the items in the *purchase order* or *production plan* previously created in the ERP:
 - a. If the delivery is complete, kencko's SC managers register the *purchase order receipt* or *production plan receipt* in the ERP by selecting the corresponding and previously created items' list and marking it as having been delivered and stored;
 - b. If there are discrepancies in the delivery, kencko's SC managers perform a root cause analysis with the 3PL and the origin site involved:
 - i. If a mistake has been made in the shipment to the 3PL warehouse, then both kencko and the 3PL register the actual items that arrived;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Inbound Logistics Processes	SC-P01.01
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- ii. If no mistake has been found in the shipment to the 3PL warehouse, kencko asks the 3PL warehouse to recheck the SKU that contains discrepancies and, if still no mistake is found, both parties register the counted items.

7. Possible Root Causes for Inventory Discrepancies

Following a chronological order for the inbound logistics processes at the 3PL warehouse, there are several actions that, if not performed correctly, will lead to mistakes that negatively influence the inventory records of all products stored at the 3PL warehouse:

1. Before the arrival at the 3PL warehouse:

- a. kencko's SC managers could forget to report to the 3PL about a future delivery by not sending an email or not registering an on-the-way delivery in the 3PL's online portal; the same mistake could be made by not registering this information in the ERP;
- b. kencko's SC managers could type the wrong products' information (SKUs, quantities, batch codes, or BBDs) in the 3PL online portal and/or in the email sent; they could also make the same mistake when registering that information in the ERP;
- c. The preparation of the loading could be done incorrectly by miscounting, losing, stealing, or damaging some of the products; additionally, the orders could simply be forgotten to be prepared and the products be left at the origin site;
- d. Regarding the transportation: some products could be damaged and thrown away or lost or stolen before the arrival; furthermore, a delivery could be made in the wrong location and simply forgotten or lost afterwards.

2. During the arrival and storage of the deliveries at the 3PL warehouse:

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Inbound Logistics Processes	SC-P01.01
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- a. Products could be damaged during the unloading at the 3PL warehouse;
- b. The 3PL operators could forget to count and register the pallets and simply store them;The 3PL operators could miscount the number of pallets or the products received;
- c. Theft may occur either at the arrival or after having been stored; additionally, some products could be stored incorrectly and later lost or forgotten;
- d. The 3PL operators could forget to let the 3PL managers know about the pallets received and stored or could report the wrong information;
- e. The 3PL managers could forget to report to kencko the arrival of the deliveries; they could forget to report to kencko detected discrepancies in the deliveries; they could also type the wrong information of the products received;
- f. kencko's SC managers could forget to register in the ERP the arrival of these deliveries; they could register the wrong information of the products received and reported by the 3PL; or they could forget to verify if the details of items received are correct.

8. Document Version Control

[What changes have occurred since publishing this procedure?]

Revision	Date of approval:	Effective Date:	Change and Reasons
NA	NA	NA	NA

Table X - Version controlling table

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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Appendix B

3PL Outbound Logistics Processes Procedure

kencko	3PL Outbound Logistics Processes	SC-P02.01
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1. Purpose

The purpose of this document is to explain in detail how the processes regarding the outbound logistics (dispatches) of food products, packaging materials, packing materials and accessories stored at the 3PL (third-party logistics) warehouse occur, as well as to mention all the existing interactions and information flow between kencko and the 3PL related to these processes.

2. Scope

This document is applicable to the Supply Chain (SC) and the Operations teams, focusing on Inventory Management.

3. Associated Documents and References

kencko's Enterprise Resource Planning (ERP) System;
The 3PL's online portal / Warehouse Management System (WMS);
3PL Extensive Guide - Inbound & Outbound Logistics Processes;
Outbound Logistics Processes at 3PL Flow Chart;
IRA Measurement - 3PL Warehouse Procedure.

4. Definitions

Term	Description
3PL (Third-party Logistics) Service Provider	A 3PL service provider offers outsourced logistics services, which include any type of management of procurement, warehousing, distribution or fulfillment processes.
Outbound Logistics	The processes and actions involved in the movements of raw materials, finished

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Outbound Logistics Processes	SC-P02.01
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Processes	goods, packaging items, and other supplies dispatched from a certain location, like a warehouse, to, for eg., a fulfillment center or manufacturer.
Information Flow	Relevant information exchange between systems and people for the effective functioning of processes, for eg., in the supply chain.
ERP - Enterprise Resource Planning System	System that automates and supports several operational and administrative business processes across various industries.
WMS - Warehouse Management System	An enterprise software application that automates and manages the processes of an organization's warehouse.

Table 1 - XXX

5. Responsibility

kencko's SC and Operations teams should follow the established protocols in the contract with the 3PL regarding the processes to be performed for the outbound logistics at the 3PL warehouse.

kencko's SC and Operations managers are responsible for continuously registering and verifying in the ERP the outbound logistics movements of all products from the 3PL warehouse.

kencko's warehouse teams are responsible for following the internal protocols regarding the processes for the transfer order receipts at the internal and external fulfillment warehouses and at the internal packing warehouse.

The **3PL** is also obligated to follow the established protocols in the contract signed along with kencko regarding the processes to be performed for the outbound logistics of products, including both physical and information flows.

The **3PL** is responsible for continuously having its WMS updated throughout these outbound logistics processes to guarantee a high level of inventory record accuracy and, in turn, to allow kencko's managers to analyze the inventory levels at the 3PL warehouse through the online portal (read *IRA Measurement - 3PL Warehouse* procedure).

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Outbound Logistics Processes	SC-P02.01
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6. Procedure

- kencko's Operations managers (for fulfillment) and SC managers (for packing) analyze the forecasts on which SKUs are needed to be replenished at the internal and external fulfillment warehouses and at the internal packing warehouse;
- kencko's Operations and SC managers create transfer orders from the 3PL warehouse to the required warehouses in the 3PL's online portal, in the *Transfers* category, by filling in the desired SKUs, quantities, batch codes and destination;
- kencko's Operations and SC managers register these transfer orders in the ERP by creating the *intersite delivery* requests with the required information of the items and locations involved;
- kencko's Operations and SC managers also notify the 3PL about these transfer orders by generating an email through the ERP with a packing list with the required information of the order automatically filled in by the system and sending it to the 3PL;
- The 3PL managers check in their WMS if the requested items, with the right batch codes and best-before-dates (BBDs), are stored at their warehouse at that moment:
 - If there are not enough quantities of a certain SKU stored in their warehouse, the 3PL managers notify kencko and ask to resend the packing list according to what is available. kencko's managers will, afterwards, run an investigation over the registered stockout and take action to correct the situation;
- The 3PL warehouse operators perform the picking process, by guiding themselves through the 3PL's WMS to see which SKUs and amounts are in the transfer order, as well as to know where those SKUs are stored;
- The 3PL warehouse operators place the prepared pallets at the dispatch zone of the 3PL warehouse and load them into a truck, for the internal fulfillment and internal packing warehouses, or into a container for the external fulfillment warehouse;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
-----------------------------	---------------------------------------	--	--------------------------

kencko	3PL Outbound Logistics Processes	SC-P02.01
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8. The 3PL transports and delivers the transfer orders at the internal fulfillment and internal packing warehouses, while another 3PL transport provider performs this service at the external fulfillment warehouse;
9. All three warehouse teams perform the unloading of the pallets, count how many of them have arrived and sign the delivery notes;
10. kencko's warehouse teams then perform an inventory check on the deliveries made (SKUs, quantities, batch codes and BBDs) and store these products in the warehouses;
11. kencko's warehouse teams report the status of the deliveries to the Operations and SC managers;
 - a. If discrepancies are found in the deliveries, kencko's Operations and SC managers inform the 3PL to understand the root cause of the problem and possibly ask for a cycle count of the SKU(s) concerned:
 - i. If it was a picking error made by the 3PL warehouse operators, kencko and the 3PL register the actual delivered quantities and the 3PL may send the missing quantities and/or perform the reverse logistics if requested;
 - ii. If no mistake has been found, both kencko and the 3PL register the counted items on each one's side and kencko may posteriorly perform a stronger investigation;
12. kencko's Operations and SC managers register in the ERP the received items by creating the *intersite delivery receipts*, selecting the corresponding previously created *intersite delivery* and marking it as having been fully delivered.

7. Possible Root Causes for Inventory Discrepancies

Following a chronological order for the outbound logistics processes at the 3PL warehouse, there are several actions that, if not performed correctly, will lead to mistakes that negatively influence

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Outbound Logistics Processes	SC-P02.01
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the inventory records regarding the 3PL warehouse and the other locations where the items are dispatched to:

1. Before the dispatch process:

- a. kencko's SC and Operations managers could forget to either send an email to the 3PL or to register a transfer order in the 3PL's online portal; additionally, they could also forget to register the transfer order request in the ERP;
- b. kencko's SC and Operations managers could also type the wrong information of the desired products, either in the email sent or in the online portal, or even in the ERP;
- c. The 3PL's managers could forget to report the transfer order request to its warehouse operators or report the wrong products' information.

2. During and after the dispatch process:

- a. The preparation of the loading could be done incorrectly by miscounting, losing, stealing, or damaging some of the products; additionally, the orders could simply be forgotten to be prepared and the products be left at the origin site;
- b. The 3PL warehouse operators could also forget to discount the products taken from their warehouse to fulfill the order or simply perform an incorrect discount of some of those products;
- c. Regarding the transportation, some products could be damaged, thrown away, lost or stolen before arrival; additionally, a transfer order could be made in the wrong location and simply forgotten or lost afterwards.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (15.03.22)	Approved By: SC Director (15.03.22)	Effective Date: 15.03.22
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kencko	3PL Outbound Logistics Processes	SC-P02.01
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3. During kencko's warehouse receipts:

- a. Products could be damaged during the unloading at the required locations;
- b. kencko's warehouse teams could forget to count and register the pallets by exclusively storing them instead;
- c. kencko's warehouse teams could miscount the number of pallets and the products received;
- d. Products could be stolen by kencko's warehouse teams either at the arrival or after having been stored; additionally, some products could be stored incorrectly and later lost or forgotten;
- e. kencko's warehouse teams could forget to let kencko's SC and Operations managers know about the pallets received and stored or could report the wrong information;
- f. kencko's SC and Operations managers could forget to register in the ERP the arrival of these transfer orders or register the wrong information of the products received and reported by the warehouse teams;
- g. kencko's SC and Operations managers could forget to inform the 3PL about discrepancies detected in deliveries and to perform an investigation.

8. Document Version Control

[What changes have occurred since publishing this procedure?]

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NA	NA	NA	NA

Table X - Version controlling table

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Appendix C

Inventory Count at 3PL Warehouse Procedure

kencko	Inventory Count at 3PL Warehouse	SC-P03.01
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1. Purpose

The purpose of this document is to establish a procedure for the process of an accurate inventory counting at the third-party logistics (3PL) warehouse, by describing all aspects and actions integrated in and related to that process.

This procedure will, therefore, illustrate the several steps performed by the 3PL and also how kencko's supply chain (SC) managers interact with this process.

This procedure will take into consideration the developed *IRA Measurement - 3PL Warehouse* procedure as it gives insight on the reasons that trigger these inventory counts.

2. Scope

This document is applicable to kencko's SC team, focusing on the 3PL warehouse. This procedure has also an impact on the Operations team.

This procedure can also be applicable to other inventory locations/warehouses, in full or partially.

3. Associated Documents and References

kencko's Enterprise Resource Planning (ERP) System;

The 3PL's online portal / Warehouse Management System (WMS);

IRA Measurement - 3PL Warehouse Procedure;

Inventory Count & IRA for 3PL Warehouse Flow Chart.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	Inventory Count at 3PL Warehouse	SC-P03.01
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4. Definitions

Term	Description
Physical Count	A structured approach to count all the inventory stored at a certain site, which involves the stoppage of all operational activities for a greater accuracy.
Cycle Counts	A systematic approach to count portions of the inventory at a certain site, without interrupting the routine operations, and usually performed with a certain periodicity.
3PL (Third-party Logistics) Service Provider	A 3PL service provider offers outsourced logistics services, which include any type of management of procurement, warehousing, distribution or fulfillment processes.
Information Flow	Relevant information exchange between systems and people for the effective functioning of processes, for eg., in the supply chain.
ERP - Enterprise Resource Planning System	System that automates and supports several operational and administrative business processes across various industries.
WMS - Warehouse Management System	An enterprise software application that automates and manages the processes of an organization's warehouse.
IRA - Inventory Record Accuracy	The accuracy level of the inventory records when compared to the physical inventory actually stored at a certain location.

Table 1 - Definitions

5. Responsibility

kencko's SC managers are responsible for keeping track of the inventory levels at the 3PL warehouse and asking for inventory counts whenever necessary, whether it is a physical count of the whole inventory stored or cycle counts of smaller SKU portions, according to a certain periodicity or whenever discrepancies in a SKU are registered (read the reasons for inventory counts in the *IRA Measurement - 3PL Warehouse* procedure).

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	Inventory Count at 3PL Warehouse	SC-P03.01
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The **3PL** is obligated to follow the established protocols in the contract signed along with kencko regarding the cycle counts in its warehouse, when solicited by kencko, for portions of SKUs and at least one annual physical count of all kencko's inventory.

The **3PL** is responsible for correctly updating its WMS with the results from the inventory counts and communicating to kencko's SC managers those same results, as well as the previous inventory records.

kencko's SC managers are responsible for analyzing and comparing the differences registered, performing the IRA measurement and making a decision on the differences found.

These responsibilities are critical to ensure the inventory records are accurate, due to the fact that, if not correctly performed, the negative impact on the business continuity will be extensive.

6. Procedure

Physical Count Process

1. kencko's SC managers internally discuss a date for a physical count to be performed and then schedule it with the 3PL managers;
 - i. Neither the Operations team, in charge of the internal and external fulfillment warehouses, nor the in-house packing warehouse team will be allowed to send a transfer order request in the previous 24 hours of the day of the physical count in order to freeze all activities;
 - ii. Also, no inbound logistics processes at the 3PL warehouse should occur in the previous 24 hours of the day of the physical count: (i.e. deliveries from the internal and external packing warehouses or any supplier);

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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k'encko	Inventory Count at 3PL Warehouse	SC-P03.01
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- a. Therefore, any deliveries received at the 3PL warehouse during this period will be left on hold at the unloading zone and only registered and stored after the physical count has been performed;
2. For the day of the physical count, the 3PL managers assign the task to some of its warehouse operators:
 - i. Usually, one operator will be handling the warehouse stacker to reach the pallets stored on the pallet racks, while another operator performs the physical count;
3. The 3PL managers handout a spreadsheet printed from their WMS beforehand to the operator performing the physical count, containing the information registered in the system, more specifically what is supposedly stored on each pallet in terms of SKU, quantities, batch codes and best-before dates (BBDs);
 - i. These pallets are identified in the spreadsheet thanks to the labeling process previously performed by the 3PL operators to identify each pallet according to the location of the pallet rack they are stored at;
4. The 3PL warehouse operators perform the physical count with no specific order and they use the pallet stacker to elevate themselves to the intended level of the pallet racks without having to bring each pallet down to the ground to perform the count;
 - i. If it is not possible to use this approach for certain pallets due to lack of visibility, they are brought to the ground for the items to be properly counted and brought back up after that;
5. As the 3PL warehouse operator counts the items on each pallet, they register them in the spreadsheet with a pencil:
 - a. Either by checking with a  mark if the information of a pallet's items is correct;
 - b. Or by writing down the actual SKU / quantities / batch codes / BBDs if any of these characteristics do not correspond to the records;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	Inventory Count at 3PL Warehouse	SC-P03.01
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6. After having finished the physical count, the 3PL warehouse operators give the spreadsheet with the results to the 3PL managers in order to update their WMS. The information is then organized by SKU and sent to kencko via email, along with the original spreadsheet used;
7. kencko's SC managers then compare the results with the inventory records by:
 - i. Making any necessary corrections in the ERP;
 - ii. Calculating the IRA metrics and taking action if the results are not satisfactory (check *IRA Measurement - 3PL Warehouse* procedure).

Note: kencko is entitled to allocate resources/employees to visit the 3PL's premises, including helping with the physical count of the inventory (with a previous warning).

Cycle Count Process:

1. After having established a periodicity for cycle counts (one every two months), as well as the size of the portions for each one (around 10% of all SKUs), kencko's SC managers send the request to the 3PL managers, indicating which SKUs they want to be counted:
 - i. The SC manager responsible for the 3PL warehouse meets with the other SC managers to select the SKUs from each team to be counted (i.e.: from Supply Planning, Sourcing & Purchasing, Material Planning and Packing teams);
2. A single cycle count for a certain SKU may also be performed regardless of the established periodicity whenever discrepancies are registered between kencko's ERP and the 3PL's WMS;
3. The rest of the cycle counts' process is equal to the process of the physical count.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	Inventory Count at 3PL Warehouse	SC-P03.01
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7. Possible Root Causes for Inventory Discrepancies

Some mistakes that could be made throughout this procedure should be avoided in order to reduce the chances of registering new inventory discrepancies or having problems related to the inventory records:

1. kencko's SC managers forgetting to ask the 3PL for physical or cycle counts when necessary;
2. kencko's SC managers forgetting to respect the 24-hour frozen period prior to the physical count for both inbound and outbound logistics processes;
3. The 3PL managers forgetting/ignoring the counting request from kencko;
4. The inventory count being incorrectly performed;
5. Some of the items' characteristics being ignored/not checked, such as batch codes or BBDs;
6. The results being incorrectly registered in the spreadsheet by the warehouse 3PL operators or by the 3PL managers in their WMS;
7. kencko's SC managers incorrectly registering the results in the ERP.

8. Document Version Control

[What changes have occurred since publishing this procedure?]

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Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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Appendix D

IRA Measurement – 3PL warehouse Procedure

kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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1. Purpose

The purpose of this document is to establish a management procedure to perform the measurement of the inventory record accuracy (IRA) in kencko's ERP system and the 3PL's (third-party logistics) WMS of all the products stored in the 3PL warehouse (food products, packaging materials, packing materials, accessories and any other products kencko might decide to store).

This procedure will also illustrate the different scenarios that trigger the necessity of the IRA measurement of the inventory at the 3PL warehouse, as well as which action steps should be taken after discrepancies have been detected.

This procedure will take into consideration the procedures developed for the inbound and outbound logistics processes at the 3PL warehouse, including several aspects in those processes that influence the IRA levels of the products stored.

2. Scope

This document is applicable to kencko's Supply Chain (SC) team, focusing on Inventory Management at the 3PL warehouse. This procedure also has an impact on the Operations team.

This procedure can also be applicable to other inventory locations/warehouses, in full or partially.

3. Associated Documents and References

kencko's Enterprise Resource Planning (ERP) System;

The 3PL's online portal / Warehouse Management System (WMS);

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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k'encko	IRA Measurement - 3PL Warehouse	SC-P04.01
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3PL Inbound Logistics Processes;
3PL Outbound Logistics Processes;
Inventory Count at 3PL Warehouse;
3PL Extensive Guide - Inbound & Outbound Logistics Processes;
Inventory Count & IRA for 3PL Warehouse Flow Chart.

4. Definitions

Term	Description
IRA - Inventory Record Accuracy	The accuracy level of the inventory records when compared to the physical inventory actually stored at a certain location.
SKU Integrity	How accurate the inventory records are regarding the proportion of accurate SKUs from the total of counted SKUs.
Absolute Deviation	How accurate the inventory records are according to the absolute value of the deviation between the recorded and counted inventory.
3PL (Third-party Logistics) Service Provider	A 3PL service provider offers outsourced logistics services, which include any type of management of procurement, warehousing, distribution or fulfillment processes.
Physical Count	A structured approach to count all the inventory stored at a certain site, which involves the stoppage of all operational activities for a greater accuracy.
Cycle Counts	A systematic approach to count portions of the inventory at a certain site, without interrupting the routine operations, and usually performed with a certain periodicity.
Inbound and Outbound Logistics Processes	The processes and actions involved in the movements of raw materials, finished goods, packaging items, and other supplies to and from a certain location, such as a warehouse.
Information Flow	Relevant information exchange between systems and people for the effective functioning of processes, for eg., in the supply chain.
ERP - Enterprise Resource Planning System	System that automates and supports several operational and administrative business processes across various industries.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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WMS - Warehouse Management System	An enterprise software application that automates and manages the processes of an organization's warehouse.
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Table 1 - Definitions

5. Responsibility

kencko's SC managers are responsible for continuously registering and verifying in the ERP the inventory levels of all products in the 3PL warehouse, as well as all the inbound and outbound logistics processes that occur in it.

The **3PL** is obligated to follow the established protocols in the contract signed along with kencko regarding the processes to be performed for the inbound and outbound logistics of products, including both physical and information flows. The 3PL is also responsible for doing cycle counts in its warehouse, when solicited by kencko, for some SKUs and at least one annual physical count of all kencko's inventory.

The **3PL** is responsible for continuously having its WMS updated throughout these inbound and outbound logistics processes to guarantee a high level of inventory record accuracy and, in turn, to allow kencko's managers to analyze the inventory levels at the 3PL warehouse through the online portal.

The **3PL** is responsible for cooperating with kencko whenever a root cause analysis of the inventory levels is performed by kencko and it may be made accountable for possible inventory losses registered.

kencko's warehouse teams are responsible for following the internal protocols regarding the processes for the transfer order receipts at the internal and external fulfillment warehouses and at the internal packing warehouse.

These responsibilities are critical to ensure the inventory records are accurate, due to the fact

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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that, if not correctly performed, the negative impact on the business continuity will be extensive.

6. Procedure

Triggers for the IRA Measurement

The procedure for the IRA measurement, consisted of the SKU Integrity and the Absolute Deviation, of the inventory stored at the 3PL warehouse may be triggered by different occasions:

- When inventory discrepancies (i.e. either in SKUs, quantities, batch codes or best-before-dates (BBDs)) between kencko's ERP and the 3PL's online portal / WMS are registered and the root cause of the problem is not found;
- When, at first, there are no discrepancies between kencko's ERP and the 3PL's online portal / WMS but there is, in fact, an inventory record error which will be eventually found (for eg.: in out-of-stock situations when the 3PL is not able to satisfy a transfer order request from kencko in its entirety);
- Whenever occasional cycle counts are requested by kencko for a better visibility, more accurate inventory records throughout time, smaller discrepancies and an easier reconciliation;
- Whenever the annual physical count of all the inventory stored established in the contract with the 3PL is performed;
- Whenever any activities besides routine processes require a physical count for accurate inventory records (for eg.: ERP implementation).

IRA Measurement Sequential Approach

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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1. kencko's SC managers initiate the IRA measurement process by requesting the 3PL managers a physical count of all the inventory stored at their warehouse or cycle counts in different occasions for portions of the SKUs;
2. After an inventory count has been performed by the 3PL operators, the 3PL managers update their WMS and send the results in a spreadsheet to kencko via email with the registered information in the count (SKUs, quantities, batch codes and BBDs) along with the information in their WMS prior to the count;
3. kencko's SC managers then perform the SKU Integrity measurement, in terms of the quantities' accuracy, by applying the following formula to the inventory records in the ERP and the 3PL's WMS:

$$SKU\ Integrity\ (\%) = \frac{Number\ of\ Accurate\ SKUs}{Total\ Number\ of\ Counted\ SKUs} * 100$$

- i. This calculation is performed separately for the inventory records on the ERP and the 3PL's WMS after a physical count of all the inventory or after each cycle count of portions of SKUs and it is used for a simple overall analysis on the 3PL's and kencko's IRA performances. The results from the SKU Integrity should be as close as a perfect result of 100%;
4. For the Absolute Deviation, kencko's SC managers subsequently analyze all SKUs individually by comparing the quantities' differences between the information received from the count and the inventory records in the ERP and the 3PL's online portal. This process starts with the following formulas for each SKU:

$$Absolute\ Deviation\ (\%) = \frac{|Counted\ Units - Record\ Units|}{Record\ Units} * 100$$

$$IRA\ (\%) = 100 - Absolute\ Deviation$$

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC P04.01
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- i. If both the record units and the counted units are equal to 0, the absolute deviation is 0% and the inventory record is 100% accurate;
 - ii. If the record units are equal to 0 and the counted units are different than 0, the absolute deviation is 100% and the inventory record is 0% accurate;
5. Having performed the calculations for each SKU regarding the ERP and the 3PL's WMS, the results translate into a deviation percentage for each SKU and into an IRA percentage on the opposite side.
6. After reaching the absolute deviation and IRA percentages for each SKU, the same formulas are then applied to the absolute sum of all the SKUs' discrepancies, which is divided by the sum of all SKUs' quantities. This calculation will, therefore, lead to a total absolute deviation and total IRA percentages of all SKUs combined for a more general view.
 - i. Both the individual and collective results should be as close as 0% of Absolute Deviation and, in turn, 100% accurate.

Action Steps for Detected Inventory Discrepancies

1. In order to evaluate the relevance of the size of each SKU discrepancy for further corrective actions, a 2% tolerance limit for the Absolute Deviation metric was established:
2. If the Absolute Deviation of a certain SKU is below the 2% mark in both the ERP and the 3PL's WMS, then kencko's SC managers may decide to simply correct the inventory record in the ERP with the result from the inventory count without needing a root cause analysis to be performed, or to still perform it if it is intended;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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3. If the Absolute Deviation of a certain SKU is above the 2% mark either in the ERP or the 3PL's WMS, then kencko's SC managers will proceed with a root cause analysis, possibly along with the 3PL's managers, for the SKU concerned. They will investigate (within a maximum of 2 weeks) kencko's inbound/outbound records history in the ERP and the 3PL's online portal to determine if there was a mistake made in them or not:
 - a. If a mistake has been made in the ERP and/or the 3PL's WMS, a correction is performed following the conclusions taken from the root cause analysis to match the actual quantities registered in the inventory count;
 - i. In case the differences detected are impacting the regular physical flow processes, it is recommended to perform the inventory correction ahead of the root cause analysis. Regardless, the root cause analysis should always be performed;
 - b. If, after the two weeks of investigation, it is not possible to identify the error/mistake, an inventory update is performed in kencko's ERP and the 3PL may be made accountable for the differences registered, meaning that kencko will be eventually entitled to ask for a compensation if there is an inventory loss.
 - i. Having made the 3PL accountable for an inventory loss, the detected discrepancies are multiplied by the SKU's unit price to reach the total value loss to be communicated to the 3PL.

Inventory Records' Monitoring

In order to facilitate the monitoring of the inventory levels at the 3PL, it is necessary to continuously guarantee that both the ERP and the 3PL's WMS are totally aligned with each other. That being said, kencko's SC managers should establish a periodicity (at least once every two weeks) for the comparison of the inventory records in the ERP and the 3PL's online portal.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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That way, in case discrepancies are detected, it will be easier to perform a root cause analysis to correct the existing mistake and possibly without having to perform a cycle/physical count to reach a conclusion.

7. Possible Root Causes for Inventory Discrepancies

Inbound Logistics Processes

Following a chronological order for the inbound logistics processes at the 3PL warehouse, and taking into account the corresponding procedure developed, there are several actions that, if not performed correctly, will lead to mistakes that negatively influence the inventory records of all products stored at the 3PL warehouse:

1. Before the arrival at the 3PL warehouse:

- a. kencko's SC managers could forget to report to the 3PL about a future delivery by not sending an email or not registering an on-the-way delivery in the 3PL's online portal; the same mistake could be made by not registering this information in the ERP;
- b. kencko's SC managers could type the wrong products' information (SKUs, quantities, batch codes, or BBDs) in the 3PL online portal and/or in the email sent; they could also make the same mistake when registering that information in the ERP;
- c. The preparation of the loading could be done incorrectly by miscounting, losing, stealing, or damaging some of the products; additionally, the orders could simply be forgotten to be prepared and the products be left at the origin site;
- d. Regarding the transportation: some products could be damaged and thrown away or lost or stolen before the arrival; furthermore, a delivery could be made in the wrong location and simply forgotten or lost afterwards.

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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2. During the arrival and storage of the deliveries at the 3PL warehouse:

- a. Products could be damaged during the unloading at the 3PL warehouse;
- b. The 3PL operators could forget to count and register the pallets and simply store them; The 3PL operators could miscount the number of pallets or the products received;
- c. Theft may occur either at the arrival or after having been stored; additionally, some products could be stored incorrectly and later lost or forgotten;
- d. The 3PL operators could forget to let the 3PL managers know about the pallets received and stored or could report the wrong information;
- e. The 3PL managers could forget to report to kencko the arrival of the deliveries; they could forget to report to kencko detected discrepancies in the deliveries; they could also type the wrong information of the products received;
- f. kencko's SC managers could forget to register in the ERP the arrival of these deliveries; they could register the wrong information of the products received and reported by the 3PL; or they could forget to verify if the details of items received are correct.

Outbound Logistics Processes

Also following a chronological order for the outbound logistics processes at the 3PL warehouse, and taking into account the corresponding procedure developed, there is a similar range of possible mistakes that could happen throughout these processes that also negatively affect the inventory records regarding the 3PL warehouse and the other locations where the items are dispatched to:

1. Before the dispatch process:

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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- a. kencko's SC and Operations managers could forget to either send an email to the 3PL or to register a transfer order in the 3PL's online portal; additionally, they could also forget to register the transfer order request in the ERP;
- b. kencko's SC and Operations managers could also type the wrong information of the desired products, either in the email sent or in the online portal, or even in the ERP;
- c. The 3PL's managers could forget to report the transfer order request to its warehouse operators or report the wrong products' information.

2. During and after the dispatch process:

- a. The preparation of the loading could be done incorrectly by miscounting, losing, stealing, or damaging some of the products; additionally, the orders could simply be forgotten to be prepared and the products be left at the origin site;
- b. The 3PL warehouse operators could also forget to discount the products taken from their warehouse to fulfill the order or simply perform an incorrect discount of some of those products;
- c. Regarding the transportation, some products could be damaged, thrown away, lost or stolen before arrival; additionally, a transfer order could be made in the wrong location and simply forgotten or lost afterwards.

3. During kencko's warehouse receipts:

- a. Products could be damaged during the unloading at the required locations;
- b. kencko's warehouse teams could forget to count and register the pallets by exclusively storing them instead;

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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kencko	IRA Measurement - 3PL Warehouse	SC-P04.01
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- c. kencko's warehouse teams could miscount the number of pallets and the products received;
- d. Products could be stolen by kencko's warehouse teams either at the arrival or after having been stored; additionally, some products could be stored incorrectly and later lost or forgotten;
- e. kencko's warehouse teams could forget to let kencko's SC and Operations managers know about the pallets received and stored or could report the wrong information;
- f. kencko's SC and Operations managers could forget to register in the ERP the arrival of these transfer orders or register the wrong information of the products received and reported by the warehouse teams;
- g. kencko's SC and Operations managers could forget to inform the 3PL about discrepancies detected in deliveries and to perform an investigation.

8. Document Version Control

[What changes have occurred since publishing this procedure?]

Revision	Date of approval:	Effective Date:	Change and Reasons
NA	NA	NA	NA

Table X - Version controlling table

Elaborated by: Miguel Costa	Reviewed by: SC Manager (18.04.22)	Approved By: SC Director (18.04.22)	Effective Date: 18.04.22
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Appendix E

3PL's WMS IRA Results from the 26th of January's Physical Count

26/01 Physical Count						
3PL's IRA - WMS						
SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA	
10010013	0	0	0	0,00%	100,00%	
10010014	0	0	0	0,00%	100,00%	
10010015	45750	45750	0	0,00%	100,00%	
10010016	0	0	0	0,00%	100,00%	
10010017	1500	1500	0	0,00%	100,00%	
10010018	12750	12750	0	0,00%	100,00%	
10010028	77250	77250	0	0,00%	100,00%	
10010029	7500	7500	0	0,00%	100,00%	
10010024	24750	24750	0	0,00%	100,00%	
10010025	200250	200250	0	0,00%	100,00%	
10010027	0	0	0	0,00%	100,00%	
10010033	17250	17250	0	0,00%	100,00%	
10010034	34500	34500	0	0,00%	100,00%	
10010035	11250	11250	0	0,00%	100,00%	
10010036	36750	36750	0	0,00%	100,00%	
10010037	0	0	0	0,00%	100,00%	
10010039	0	0	0	0,00%	100,00%	
10010040	60000	60000	0	0,00%	100,00%	
10010038	47250	47250	0	0,00%	100,00%	
10030001	34000	34000	0	0,00%	100,00%	
10030002	19000	19000	0	0,00%	100,00%	
10030003	16500	16500	0	0,00%	100,00%	
10030004	28000	28000	0	0,00%	100,00%	
10020001	0	0	0	0,00%	100,00%	
10020003	0	0	0	0,00%	100,00%	
10020006	0	0	0	0,00%	100,00%	
10020008	0	0	0	0,00%	100,00%	
10020009	0	0	0	0,00%	100,00%	
10020011	0	0	0	0,00%	100,00%	
10000002	15400	15400	0	0,00%	100,00%	
10000003	19520	19520	0	0,00%	100,00%	
90000016	0	0	0	0,00%	100,00%	
90000022	2750	2750	0	0,00%	100,00%	
90000019	32950	32950	0	0,00%	100,00%	
90000023	30150	30150	0	0,00%	100,00%	
90000024	7250	7250	0	0,00%	100,00%	
90000025	8350	8350	0	0,00%	100,00%	
90000020	125400	125400	0	0,00%	100,00%	
90000026	16100	16100	0	0,00%	100,00%	
90000027	15800	14800	1000	6,76%	93,24%	
90000021	13400	13400	0	0,00%	100,00%	
90000031	0	0	0	0,00%	100,00%	
90000029	0	0	0	0,00%	100,00%	
90000032	900	900	0	0,00%	100,00%	
90010003	18500	18429	71	0,39%	99,61%	
90010006	214800	214800	0	0,00%	100,00%	
90010004	42900	42900	0	0,00%	100,00%	
90010005	26350	26350	0	0,00%	100,00%	
90010007	23400	23400	0	0,00%	100,00%	
90010009	5050	5050	0	0,00%	100,00%	
90010008	1550	1550	0	0,00%	100,00%	
90020008	4350	4350	0	0,00%	100,00%	
90020011	8950	9000	50	0,56%	99,44%	
90020016	43300	43300	0	0,00%	100,00%	
90020017	127700	136500	8800	6,45%	93,55%	
90020009	53650	53650	0	0,00%	100,00%	
90020010	34400	33900	500	1,47%	98,53%	
90020020	0	0	0	0,00%	100,00%	
90020019	5200	5450	250	4,59%	95,41%	
90020022	0	0	0	0,00%	100,00%	
90020023	0	0	0	0,00%	100,00%	
90020021	0	0	0	0,00%	100,00%	
90020028	800	800	0	0,00%	100,00%	
90020024	1100	1100	0	0,00%	100,00%	
51020007	46	46	0	0,00%	100,00%	
51020008	33	33	0	0,00%	100,00%	
51020009	6	0	6	100,00%	0,00%	
51020010	36	33	3	9,09%	90,91%	
51020011	57	57	0	0,00%	100,00%	
51020012	25	25	0	0,00%	100,00%	
51020013	21	21	0	0,00%	100,00%	
51020014	19	19	0	0,00%	100,00%	
51020017	20	20	0	0,00%	100,00%	
Total	1574483	1582003	10680	0,68%	99,32%	
SKU Integrity = 89,04%						

Appendix F

3PL's WMS IRA Results from the 16th of February's Physical Count

16/02 Physical Count
3PL's IRA - WMS

SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA
10010013	0	0	0	0,00%	100,00%
10010014	5250	5250	0	0,00%	100,00%
10010015	0	0	0	0,00%	100,00%
10010016	42750	42750	0	0,00%	100,00%
10010017	0	0	0	0,00%	100,00%
10010018	0	0	0	0,00%	100,00%
10010028	25500	25500	0	0,00%	100,00%
10010029	5250	5250	0	0,00%	100,00%
10010024	0	0	0	0,00%	100,00%
10010025	24750	24750	0	0,00%	100,00%
10010027	0	0	0	0,00%	100,00%
10010033	45000	45000	0	0,00%	100,00%
10010034	10500	10500	0	0,00%	100,00%
10010035	31500	31500	0	0,00%	100,00%
10010036	27000	27000	0	0,00%	100,00%
10010037	78000	78000	0	0,00%	100,00%
10010039	0	0	0	0,00%	100,00%
10010040	8250	8250	0	0,00%	100,00%
10010038	2250	2250	0	0,00%	100,00%
10030001	29500	29500	0	0,00%	100,00%
10030002	41000	41000	0	0,00%	100,00%
10030003	37000	37000	0	0,00%	100,00%
10030004	47500	47500	0	0,00%	100,00%
10020001	0	0	0	0,00%	100,00%
10020003	0	0	0	0,00%	100,00%
10020006	0	0	0	0,00%	100,00%
10020008	0	0	0	0,00%	100,00%
10020009	0	0	0	0,00%	100,00%
10020011	0	0	0	0,00%	100,00%
10000002	1600	1600	0	0,00%	100,00%
10000003	17040	17040	0	0,00%	100,00%
90000016	2000	2000	0	0,00%	100,00%
90000022	2700	2700	0	0,00%	100,00%
90000019	40550	40550	0	0,00%	100,00%
90000023	23050	23050	0	0,00%	100,00%
90000024	6300	6300	0	0,00%	100,00%
90000025	7150	7150	0	0,00%	100,00%
90000020	76800	76900	100	0,13%	99,87%
90000026	28500	28500	0	0,00%	100,00%
90000027	5300	5300	0	0,00%	100,00%
90000021	13900	13900	0	0,00%	100,00%
90000031	1020	1020	0	0,00%	100,00%
90000029	4900	4900	0	0,00%	100,00%
90000032	7200	7200	0	0,00%	100,00%
90010003	17479	17479	0	0,00%	100,00%
90010006	363600	363600	0	0,00%	100,00%
90010004	7470	7470	0	0,00%	100,00%
90010005	19600	19600	0	0,00%	100,00%
90010007	23400	23400	0	0,00%	100,00%
90010009	5050	5050	0	0,00%	100,00%
90010008	500	500	0	0,00%	100,00%
90020008	4200	4200	0	0,00%	100,00%
90020011	7850	7850	0	0,00%	100,00%
90020016	50000	50000	0	0,00%	100,00%
90020017	79450	79550	100	0,13%	99,87%
90020009	62750	62750	0	0,00%	100,00%
90020010	14050	14050	0	0,00%	100,00%
90020020	0	0	0	0,00%	100,00%
90020019	5200	5200	0	0,00%	100,00%
90020022	0	0	0	0,00%	100,00%
90020023	0	0	0	0,00%	100,00%
90020021	0	0	0	0,00%	100,00%
90020028	7000	7000	0	0,00%	100,00%
90020024	7400	7400	0	0,00%	100,00%
51020007	46	46	0	0,00%	100,00%
51020008	33	33	0	0,00%	100,00%
51020009	0	0	0	0,00%	100,00%
51020010	36	36	0	0,00%	100,00%
51020011	0	0	0	0,00%	100,00%
51020012	25	25	0	0,00%	100,00%
51020013	0	0	0	0,00%	100,00%
51020014	19	19	0	0,00%	100,00%
51020017	20	20	0	0,00%	100,00%
Total	1374188	1374388	200	0,01%	99,99%

SKU Integrity = 97,26%

Appendix G

3PL's WMS IRA Results from the 5th of May's Physical Count

05/05 Physical Count
3PL's IRA - WMS

SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA
10010013	0	0	0	0,00%	100,00%
10010014	0	0	0	0,00%	100,00%
10010015	0	0	0	0,00%	100,00%
10010016	0	0	0	0,00%	100,00%
10010017	0	0	0	0,00%	100,00%
10010018	0	0	0	0,00%	100,00%
10010028	0	0	0	0,00%	100,00%
10010029	51000	51000	0	0,00%	100,00%
10010024	75000	75000	0	0,00%	100,00%
10010025	116250	116250	0	0,00%	100,00%
10010027	58500	58500	0	0,00%	100,00%
10010033	56250	56250	0	0,00%	100,00%
10010034	6750	6750	0	0,00%	100,00%
10010035	9750	9750	0	0,00%	100,00%
10010036	42750	42750	0	0,00%	100,00%
10010037	2250	2250	0	0,00%	100,00%
10010039	18000	18000	0	0,00%	100,00%
10010040	21000	21000	0	0,00%	100,00%
10010041	15000	15000	0	0,00%	100,00%
10010042	15000	15000	0	0,00%	100,00%
10010038	54000	54000	0	0,00%	100,00%
10030001	95000	95000	0	0,00%	100,00%
10030002	37000	37000	0	0,00%	100,00%
10030003	35500	35500	0	0,00%	100,00%
10030004	30000	30000	0	0,00%	100,00%
10030005	14500	14500	0	0,00%	100,00%
10030006	17500	17500	0	0,00%	100,00%
10020001	0	0	0	0,00%	100,00%
10020003	0	0	0	0,00%	100,00%
10020006	0	0	0	0,00%	100,00%
10020008	0	0	0	0,00%	100,00%
10020009	0	0	0	0,00%	100,00%
10020011	0	0	0	0,00%	100,00%
10020013	0	0	0	0,00%	100,00%
10020014	0	0	0	0,00%	100,00%
10000004	33000	33000	0	0,00%	100,00%
10000003	17040	17040	0	0,00%	100,00%
90000016	1500	1500	0	0,00%	100,00%
90000022	1250	1250	0	0,00%	100,00%
90000019	55050	55050	0	0,00%	100,00%
90000023	46200	46200	0	0,00%	100,00%
90000024	11550	11550	0	0,00%	100,00%
90000025	550	550	0	0,00%	100,00%
90000020	56550	56550	0	0,00%	100,00%
90000026	29800	29800	0	0,00%	100,00%
90000027	8750	8750	0	0,00%	100,00%
90000021	13900	13900	0	0,00%	100,00%
90000031	1020	1020	0	0,00%	100,00%
90000029	4900	4900	0	0,00%	100,00%
90000032	5450	5450	0	0,00%	100,00%
90010003	7079	7079	0	0,00%	100,00%
90010006	320100	320100	0	0,00%	100,00%
90010004	51725	51725	0	0,00%	100,00%
90010005	36185	36185	0	0,00%	100,00%
90010007	23400	23400	0	0,00%	100,00%
90010009	25125	25125	0	0,00%	100,00%
90010008	9028	9028	0	0,00%	100,00%
90020008	2850	2850	0	0,00%	100,00%
90020011	4650	4650	0	0,00%	100,00%
90020016	64750	64750	0	0,00%	100,00%
90020017	60300	60300	0	0,00%	100,00%
90020009	90150	90150	0	0,00%	100,00%
90020010	23400	23400	0	0,00%	100,00%
90020020	0	0	0	0,00%	100,00%
90020019	5700	5200	500	9,62%	90,38%
90020022	0	0	0	0,00%	100,00%
90020023	21600	21600	0	0,00%	100,00%
90020021	4500	4500	0	0,00%	100,00%
90020028	5250	5250	0	0,00%	100,00%
90020024	7400	7400	0	0,00%	100,00%
51020007	0	0	0	0,00%	100,00%
51020008	0	0	0	0,00%	100,00%
51020009	126	126	0	0,00%	100,00%
51020010	0	0	0	0,00%	100,00%
51020011	0	0	0	0,00%	100,00%
51020012	0	0	0	0,00%	100,00%
51020013	0	0	0	0,00%	100,00%
51020014	0	0	0	0,00%	100,00%
51020017	0	0	0	0,00%	100,00%
Total	1820828	1820328	500	0,03%	99,97%

SKU Integrity = 98,73%

Appendix H

kencko's Google Sheets IRA Results from the 26th of January's Physical Count

26/01 Physical Count
kencko's IRA - Google Sheets

SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA
10010013	0	12000	12000	100,00%	0,00%
10010014	0	12000	12000	100,00%	0,00%
10010015	45750	82068	36318	44,25%	55,75%
10010016	0	0	0	0,00%	100,00%
10010017	1500	1500	0	0,00%	100,00%
10010018	12750	49222	36472	74,10%	25,90%
10010028	77250	109500	32250	29,45%	70,55%
10010029	7500	7500	0	0,00%	100,00%
10010024	24750	36750	12000	32,65%	67,35%
10010025	200250	180000	20250	11,25%	88,75%
10010027	0	12000	12000	100,00%	0,00%
10010033	17250	17250	0	0,00%	100,00%
10010034	34500	19500	15000	76,92%	23,08%
10010035	11250	-16500	11250	100,00%	0,00%
10010036	36750	36750	0	0,00%	100,00%
10010037	0	0	0	0,00%	100,00%
10010039	0	-45000	0	100,00%	0,00%
10010040	60000	60000	0	0,00%	100,00%
10010038	47250	48000	750	1,56%	98,44%
10030001	34000	34000	0	0,00%	100,00%
10030002	19000	19000	0	0,00%	100,00%
10030003	16500	16500	0	0,00%	100,00%
10030004	28000	28000	0	0,00%	100,00%
10020001	0	0	0	0,00%	100,00%
10020003	0	0	0	0,00%	100,00%
10020006	0	0	0	0,00%	100,00%
10020008	0	0	0	0,00%	100,00%
10020009	0	0	0	0,00%	100,00%
10020011	0	0	0	0,00%	100,00%
10000002	15400	13600	1800	13,24%	86,76%
10000003	19520	-240	19520	100,00%	0,00%
90000016	0	0	0	0,00%	100,00%
90000022	2750	1350	1400	103,70%	-3,70%
90000019	32950	1400	31550	2253,57%	-2153,57%
90000023	30150	25150	5000	19,88%	80,12%
90000024	7250	7500	250	3,33%	96,67%
90000025	8350	8350	0	0,00%	100,00%
90000020	125400	121850	3550	2,91%	97,09%
90000026	16100	16100	0	0,00%	100,00%
90000027	15800	17800	2000	11,24%	88,76%
90000021	13400	13900	500	3,60%	96,40%
90000031	0	0	0	0,00%	100,00%
90000029	0	0	0	0,00%	100,00%
90000032	900	900	0	0,00%	100,00%
90010003	18500	29200	10700	36,64%	63,36%
90010006	214800	146700	68100	46,42%	53,58%
90010004	42900	32770	10130	30,91%	69,09%
90010005	26350	19350	7000	36,18%	63,82%
90010007	23400	23400	0	0,00%	100,00%
90010009	5050	0	5050	100,00%	0,00%
90010008	1550	1550	0	0,00%	100,00%
90020008	4350	3000	1350	45,00%	55,00%
90020011	8950	7150	1800	25,17%	74,83%
90020016	43300	9750	33550	344,10%	-244,10%
90020017	127700	136500	8800	6,45%	93,55%
90020009	53650	53150	500	0,94%	99,06%
90020010	34400	17500	16900	96,57%	3,43%
90020020	0	23400	23400	100,00%	0,00%
90020019	5200	0	5200	100,00%	0,00%
90020022	0	0	0	0,00%	100,00%
90020023	0	0	0	0,00%	100,00%
90020021	0	550	550	100,00%	0,00%
90020028	800	800	0	0,00%	100,00%
90020024	1100	1100	0	0,00%	100,00%
51020007	46	46	0	0,00%	100,00%
51020008	33	33	0	0,00%	100,00%
51020009	6	6	0	0,00%	100,00%
51020010	36	36	0	0,00%	100,00%
51020011	57	57	0	0,00%	100,00%
51020012	25	25	0	0,00%	100,00%
51020013	21	21	0	0,00%	100,00%
51020014	19	19	0	0,00%	100,00%
51020017	20	20	0	0,00%	100,00%
Total	1574483	1453833	458890	31,56%	68,44%

SKU Integrity = 52,05%

Appendix I

kencko's Google Sheets IRA Results from the 16th of February's Physical Count

16/02 Physical Count kencko's IRA - Google Sheets		SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA
		10010013	0	0	0	0,00%	100,00%
		10010014	5250	16500	11250	68,18%	31,82%
		10010015	0	21432	21432	100,00%	0,00%
		10010016	42750	102750	60000	58,39%	41,61%
		10010017	0	0	0	0,00%	100,00%
		10010018	0	4778	4778	100,00%	0,00%
		10010028	25500	85500	60000	70,18%	29,82%
		10010029	5250	21750	16500	75,86%	24,14%
		10010024	0	16500	16500	100,00%	0,00%
		10010025	24750	192750	168000	87,16%	12,84%
		10010027	0	0	0	0,00%	100,00%
		10010033	45000	45000	0	0,00%	100,00%
		10010034	10500	34500	24000	69,57%	30,43%
		10010035	31500	31500	0	0,00%	100,00%
		10010036	27000	73500	46500	63,27%	36,73%
		10010037	78000	78000	0	0,00%	100,00%
		10010039	0	0	0	0,00%	100,00%
		10010040	8250	56250	48000	85,33%	14,67%
		10010038	2250	6750	4500	66,67%	33,33%
		10030001	29500	45500	16000	35,16%	64,84%
		10030002	41000	39000	2000	5,13%	94,87%
		10030003	37000	37000	0	0,00%	100,00%
		10030004	47500	47500	0	0,00%	100,00%
		10020001	0	0	0	0,00%	100,00%
		10020003	0	0	0	0,00%	100,00%
		10020006	0	0	0	0,00%	100,00%
		10020008	0	0	0	0,00%	100,00%
		10020009	0	0	0	0,00%	100,00%
		10020011	0	0	0	0,00%	100,00%
		10000002	1600	4000	2400	60,00%	40,00%
		10000003	17040	17040	0	0,00%	100,00%
		90000016	2000	0	2000	100,00%	0,00%
		90000022	2700	2700	0	0,00%	100,00%
		90000019	40550	44950	4400	9,79%	90,21%
		90000023	23050	27400	4350	15,88%	84,12%
		90000024	6300	6300	0	0,00%	100,00%
		90000025	7150	7150	0	0,00%	100,00%
		90000020	76800	116400	39600	34,02%	65,98%
		90000026	28500	41700	13200	31,65%	68,35%
		90000027	5300	14300	9000	62,94%	37,06%
		90000021	13900	13400	500	3,73%	96,27%
		90000031	1020	0	1020	100,00%	0,00%
		90000029	4900	4200	700	16,67%	83,33%
		90000032	7200	7200	0	0,00%	100,00%
		90010003	17479	17400	79	0,45%	99,55%
		90010006	363600	371600	8000	2,15%	97,85%
		90010004	7470	36400	28930	79,48%	20,52%
		90010005	19600	27600	8000	28,99%	71,01%
		90010007	23400	23400	0	0,00%	100,00%
		90010009	5050	5050	0	0,00%	100,00%
		90010008	500	500	0	0,00%	100,00%
		90020008	4200	4100	100	2,44%	97,56%
		90020011	7850	7550	300	3,97%	96,03%
		90020016	50000	54500	4500	8,26%	91,74%
		90020017	79450	119700	40250	33,63%	66,37%
		90020009	62750	76650	13900	18,13%	81,87%
		90020010	14050	32150	18100	56,30%	43,70%
		90020020	0	0	0	0,00%	100,00%
		90020019	5200	5200	0	0,00%	100,00%
		90020022	0	0	0	0,00%	100,00%
		90020023	0	0	0	0,00%	100,00%
		90020021	0	3950	3950	100,00%	0,00%
		90020028	7000	7000	0	0,00%	100,00%
		90020024	7400	7400	0	0,00%	100,00%
		51020007	46	46	0	0,00%	100,00%
		51020008	33	33	0	0,00%	100,00%
		51020009	0	0	0	0,00%	100,00%
		51020010	36	36	0	0,00%	100,00%
		51020011	0	0	0	0,00%	100,00%
		51020012	25	25	0	0,00%	100,00%
		51020013	0	0	0	0,00%	100,00%
		51020014	19	19	0	0,00%	100,00%
		51020017	20	20	0	0,00%	100,00%
Total			1374188	2063529	702739	34,06%	65,94%

SKU Integrity = 52,05%

Appendix J

kencko's Google Sheets IRA Results from the 5th of May's Physical Count

05/05 Physical Count kencko's IRA - Google Sheets						
SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA	
10010013	0	0	0	0,00%	100,00%	
10010014	0	0	0	0,00%	100,00%	
10010015	0	0	0	0,00%	100,00%	
10010016	0	0	0	0,00%	100,00%	
10010017	0	0	0	0,00%	100,00%	
10010018	0	0	0	0,00%	100,00%	
10010028	0	0	0	0,00%	100,00%	
10010029	51000	51000	0	0,00%	100,00%	
10010024	75000	75000	0	0,00%	100,00%	
10010025	116250	116250	0	0,00%	100,00%	
10010027	58500	58500	0	0,00%	100,00%	
10010033	56250	56250	0	0,00%	100,00%	
10010034	6750	6750	0	0,00%	100,00%	
10010035	9750	9750	0	0,00%	100,00%	
10010036	42750	42750	0	0,00%	100,00%	
10010037	2250	2250	0	0,00%	100,00%	
10010039	18000	18000	0	0,00%	100,00%	
10010040	21000	21000	0	0,00%	100,00%	
10010041	15000	15000	0	0,00%	100,00%	
10010042	15000	15000	0	0,00%	100,00%	
10010038	54000	54000	0	0,00%	100,00%	
10030001	95000	95000	0	0,00%	100,00%	
10030002	37000	37000	0	0,00%	100,00%	
10030003	35500	35500	0	0,00%	100,00%	
10030004	30000	30000	0	0,00%	100,00%	
10030005	14500	14500	0	0,00%	100,00%	
10030006	17500	17500	0	0,00%	100,00%	
10020001	0	0	0	0,00%	100,00%	
10020003	0	0	0	0,00%	100,00%	
10020006	0	0	0	0,00%	100,00%	
10020008	0	0	0	0,00%	100,00%	
10020009	0	0	0	0,00%	100,00%	
10020011	0	0	0	0,00%	100,00%	
10020013	0	0	0	0,00%	100,00%	
10020014	0	0	0	0,00%	100,00%	
10000004	33000	33000	0	0,00%	100,00%	
10000003	17040	17040	0	0,00%	100,00%	
90000016	1500	3500	2000	57,14%	42,86%	
90000022	1250	1250	0	0,00%	100,00%	
90000019	55050	55050	0	0,00%	100,00%	
90000023	46200	46250	50	0,11%	99,89%	
90000024	11550	11550	0	0,00%	100,00%	
90000025	550	550	0	0,00%	100,00%	
90000020	56550	56800	250	0,44%	99,56%	
90000026	29800	29900	100	0,33%	99,67%	
90000027	8750	8800	50	0,57%	99,43%	
90000021	13900	13650	250	1,83%	98,17%	
90000031	1020	2720	1700	62,50%	37,50%	
90000029	4900	5600	700	12,50%	87,50%	
90000032	5450	5450	0	0,00%	100,00%	
90010003	7079	7079	0	0,00%	100,00%	
90010006	320100	320100	0	0,00%	100,00%	
90010004	51725	52725	1000	1,90%	98,10%	
90010005	36185	29185	7000	23,98%	76,02%	
90010007	23400	22400	1000	4,46%	95,54%	
90010009	25125	25125	0	0,00%	100,00%	
90010008	9028	7528	1500	19,93%	80,07%	
90020008	2850	2850	0	0,00%	100,00%	
90020011	4650	5050	400	7,92%	92,08%	
90020016	64750	64750	0	0,00%	100,00%	
90020017	60300	59850	450	0,75%	99,25%	
90020009	90150	90400	250	0,28%	99,72%	
90020010	23400	23400	0	0,00%	100,00%	
90020020	0	0	0	0,00%	100,00%	
90020019	5700	5200	500	9,62%	90,38%	
90020022	0	0	0	0,00%	100,00%	
90020023	21600	21600	0	0,00%	100,00%	
90020021	4500	4500	0	0,00%	100,00%	
90020028	5250	5250	0	0,00%	100,00%	
90020024	7400	7400	0	0,00%	100,00%	
51020007	0	0	0	0,00%	100,00%	
51020008	0	0	0	0,00%	100,00%	
51020009	126	126	0	0,00%	100,00%	
51020010	0	0	0	0,00%	100,00%	
51020011	0	0	0	0,00%	100,00%	
51020012	0	0	0	0,00%	100,00%	
51020013	0	0	0	0,00%	100,00%	
51020014	0	0	0	0,00%	100,00%	
51020017	0	0	0	0,00%	100,00%	
Total	1820828	1816628	17200	0,95%	99,05%	
SKU Integrity = 79,75%						

Appendix K

kencko's ERP IRA Results from the 5th of May's Physical Count (Quantities)

05/05 Physical Count kencko's IRA - ERP						
SKU	Count	Records	Absolute Discrepancies	Absolute Deviation	Abs. Dev.'s IRA	
10010013	0	0	0	0,00%	100,00%	
10010014	0	0	0	0,00%	100,00%	
10010015	0	0	0	0,00%	100,00%	
10010016	0	0	0	0,00%	100,00%	
10010017	0	0	0	0,00%	100,00%	
10010018	0	0	0	0,00%	100,00%	
10010028	0	0	0	0,00%	100,00%	
10010029	51000	51000	0	0,00%	100,00%	
10010024	75000	75000	0	0,00%	100,00%	
10010025	116250	116250	0	0,00%	100,00%	
10010027	58500	58500	0	0,00%	100,00%	
10010033	56250	56250	0	0,00%	100,00%	
10010034	6750	6750	0	0,00%	100,00%	
10010035	9750	9750	0	0,00%	100,00%	
10010036	42750	42750	0	0,00%	100,00%	
10010037	2250	2250	0	0,00%	100,00%	
10010039	18000	18000	0	0,00%	100,00%	
10010040	21000	21000	0	0,00%	100,00%	
10010041	15000	15000	0	0,00%	100,00%	
10010042	15000	15000	0	0,00%	100,00%	
10010038	54000	54000	0	0,00%	100,00%	
10030001	95000	95000	0	0,00%	100,00%	
10030002	37000	37000	0	0,00%	100,00%	
10030003	35500	35500	0	0,00%	100,00%	
10030004	30000	30000	0	0,00%	100,00%	
10030005	14500	14500	0	0,00%	100,00%	
10030006	17500	17500	0	0,00%	100,00%	
10020001	0	0	0	0,00%	100,00%	
10020003	0	0	0	0,00%	100,00%	
10020006	0	0	0	0,00%	100,00%	
10020008	0	0	0	0,00%	100,00%	
10020009	0	0	0	0,00%	100,00%	
10020011	0	0	0	0,00%	100,00%	
10020013	0	0	0	0,00%	100,00%	
10020014	0	0	0	0,00%	100,00%	
10000004	33000	33000	0	0,00%	100,00%	
10000003	17040	17040	0	0,00%	100,00%	
90000016	1500	3500	2000	57,14%	42,86%	
90000022	1250	1250	0	0,00%	100,00%	
90000019	55050	55050	0	0,00%	100,00%	
90000023	46200	46250	50	0,11%	99,89%	
90000024	11550	11550	0	0,00%	100,00%	
90000025	550	550	0	0,00%	100,00%	
90000020	56550	56550	0	0,00%	100,00%	
90000026	29800	29900	100	0,33%	99,67%	
90000027	8750	8800	50	0,57%	99,43%	
90000021	13900	13900	0	0,00%	100,00%	
90000031	1020	2720	1700	62,50%	37,50%	
90000029	4900	5600	700	12,50%	87,50%	
90000032	5450	5450	0	0,00%	100,00%	
90010003	7079	7079	0	0,00%	100,00%	
90010006	320100	320100	0	0,00%	100,00%	
90010004	51725	52725	1000	1,90%	98,10%	
90010005	36185	29185	7000	23,98%	76,02%	
90010007	23400	22400	1000	4,46%	95,54%	
90010009	25125	25125	0	0,00%	100,00%	
90010008	9028	7528	1500	19,93%	80,07%	
90020008	2850	2850	0	0,00%	100,00%	
90020011	4650	5050	400	7,92%	92,08%	
90020016	64750	64750	0	0,00%	100,00%	
90020017	60300	59850	450	0,75%	99,25%	
90020009	90150	90400	250	0,28%	99,72%	
90020010	23400	23400	0	0,00%	100,00%	
90020020	0	0	0	0,00%	100,00%	
90020019	5700	5200	500	9,62%	90,38%	
90020022	0	0	0	0,00%	100,00%	
90020023	21600	21600	0	0,00%	100,00%	
90020021	4500	4500	0	0,00%	100,00%	
90020028	5250	5250	0	0,00%	100,00%	
90020024	7400	7400	0	0,00%	100,00%	
51020007	0	0	0	0,00%	100,00%	
51020008	0	0	0	0,00%	100,00%	
51020009	125	125	0	0,00%	100,00%	
51020010	0	0	0	0,00%	100,00%	
51020011	0	0	0	0,00%	100,00%	
51020012	0	0	0	0,00%	100,00%	
51020013	0	0	0	0,00%	100,00%	
51020014	0	0	0	0,00%	100,00%	
51020017	0	0	0	0,00%	100,00%	
Total	1820828	1816628	16700	0,92%	99,08%	
SKU Integrity = 82,28%						

Appendix L

kencko's ERP Results from the 5th of May's Physical Count (Batch Codes & Quantities)

05/05 Physical Count kencko's Batch Codes - ERP	SKU	Batch Code	Count	Records	
	10010013	-	0	0	
	10010014	-	0	0	
	10010015	-	0	0	
	10010016	-	0	0	
	10010017	-	0	0	
	10010018	-	0	0	
	10010028	-	0	0	
	10010024	957280322086	12750	12750	
	10010024	957280322109	41250	41250	
	10010024	957280322054	21000	21000	
	10010025	972940322083	27000	27000	
	10010025	972940322094	57000	57000	
	10010025	972940322109	32250	32250	
	10010027	961630322049	16500	16500	
	10010027	961630322090	750	750	
	10010027	961630322103	41250	41250	
	10010029	972260322074	5250	5250	
	10010029	987120322115	45750	45750	
	10010033	970340322070	56250	56250	
	10010034	972890322081	6750	6750	
	10010035	977220322089	6750	6750	
	10010035	977220322101	3000	3000	
	10010036	980720322101	30000	30000	
	10010036	980720322111	12750	12750	
	10010037	949000322033	2250	2250	
	10010038	964820322087	4500	4500	
	10010038	964820322094	4500	4500	
	10010038	964830322115	45000	45000	
	10010039	969870322068	18000	18000	
	10010040	972930322081	21000	21000	
	10010041	899240322068	15000	15000	
	10010042	899260322097	1500	1500	
	10010042	941150322062	2250	2250	
	10010042	948150322096	11250	11250	
	10030001	210720322042	12500	12500	
	10030001	210720522011	5000	5000	
	10030001	210720522021	6500	6500	
	10030001	210720522040	14000	14000	
	10030001	210720522060	4000	4000	
	10030001	210720522070	3500	3500	
	10030001	210720522073	21000	21000	
	10030001	210720522091	9500	9500	
	10030001	210720522115	11000	11000	
	10030001	220110522117	8000	8000	
	10030002	210910522028	4000	10500	Batch Code Error #1
	10030002	210910522062	1500	1500	
	10030002	210910522068	13500	13500	
	10030002	210910522075	11500	11500	
	10030002	210910522095	6500	0	Batch Code Error #1
	10030003	210720522063	16000	16000	
	10030003	210720522080	16000	16000	
	10030003	210720522096	3500	3500	
	10030004	210710522034	20500	19500	Batch Code Error #2
	10030004	210710522053	7000	8000	Batch Code Error #2
	10030004	210710522097	2500	2500	
	10030005	220310522090	3500	3500	
	10030005	220310522111	11000	11000	
	10030006	220310522084	3500	3500	
	10030006	220310522102	6500	6500	
	10030006	220310522109	7500	7500	
	10020001	-	0	0	
	10020003	-	0	0	
	10020006	-	0	0	
	10020008	-	0	0	
	10020009	-	0	0	
	10020011	-	0	0	
	10020013	-	0	0	
	10020014	-	0	0	
	Total	53	771000	771000	
Batch Code Integrity =		92,45%			